MINING SITES: HISTORIC CONTEXT AND ARCHAEOLOGICAL RESEARCH DESIGN

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CHAPTER 1. INTRODUCTION

MINING RESEARCH DESIGN: SUMMARY

The purpose of this research design is to provide general guidance for evaluating historic-era mining sites, specifically their data potential. It includes a historic context outlining important periods of mining history in the State, identification of property types, and important research themes and questions relevant to mining sites. Due to the range of natural resources in California, the scope of this document is necessarily limited to the mining of metals and those related archaeological sites. For this document, mining sites are defined as those sites containing evidence of metals-mining activities.

The period of study is 1848 through 1940. The minor and spatially limited mining that took place during the pre-Gold Rush period in California is not the subject of this context. Examples of site types may include, but are not limited to, mines, mills, shafts, adits, prospects, and placer-mining sites. These sites may include processing equipment, ruins of mine buildings and/or miners' habitations, scatters of equipment or mining debris, trash related to the miners' occupation of the site, and other related items. Where standing structures are extant (mills, headframes, support buildings), they should be considered for both their potential contributions to research and for their eligibility under other criteria. These are properly considered as historic architectural resources that, in addition to being addressed as features of the mining operation, also need to be evaluated on Department of Parks and Recreation (DPR) Building/Structure/Object forms by a qualified architectural historian. These architectural resources may also have a historical archaeological component.

The sites that are the subject of this report are related to the mining of all metals, including but not limited to gold, silver, and the other precious metals. "Base" metals such as copper, lead, mercury, tin, iron, and other non-ferrous metals used in industrial processes are also found in California and were mined at various times; some, like lead and copper, are commonly found in conjunction with gold and silver. The traces of gold and silver found with copper and lead were often a major source of profit of such mines.

This document consists of five sections:

- Chapter 1 consists of this Introduction, which outlines the document's purpose, authorship, structure, and theoretical orientation.
- Chapter 2 contains the historic context, a synthetic narrative describing the significant broad patterns of mining development in California that may be represented by historic properties.
- Chapter 3 describes archaeological property types created by the processes presented in Chapter 2. These are the features that archaeologists encounter in the field.

- Chapter 4 consists of a review of current scholarship to identify scholarly themes and develop specific research questions that information from mining sites might be able to answer.
- Chapter 5 offers an implementation plan that presents standardized methods that will enhance comparative research and guide evaluation under criterion D without hampering the imaginative process. Data requirements and issues of integrity are addressed here.

RESEARCH DESIGN SERIES

This is one of a series of statewide, thematic, archaeological research designs developed by the California Department of Transportation (Caltrans). Its purpose is to help archaeologists assess the importance of historic-era archaeological sites commonly encountered on Caltrans projects. Other volumes in this series address agricultural properties (Caltrans 2006), Town Sites, and Work Camps.

The series grew out of Caltrans's long-term efforts to improve the process of site-specific research and evaluation as well as the California State Historic Preservation Officer's recommendation that the agency improve how historical archaeology is conducted in the context of Section 106 of the National Historic Preservation Act. This statute requires that federal agencies take into account the effects of the undertakings on properties listed on or eligible to the National Register of Historic Places (NRHP).

It is important to note that this Mining Sites Research Design is concerned with NRHP criterion D under which properties may be eligible for listing if they have "yielded, or may be likely to yield, information important in prehistory or history" (36 CFR 60.4[d]). However, the historic context, approach to site identification, and recommended procedures for recording mining sites should be useful to both historians and archaeologists.

How this Document was Created

The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (48 FR 44716) state that historic contexts should be constructed by an interdisciplinary process that considers the comments of the interested public and scholars. To facilitate public comment and peer input, the authors presented their approach in symposia at the 2006 annual conference of the California Council for the Promotion of History. A similar presentation was made at the Society for California Archaeology's 2006 northern data-sharing meeting. A review draft was posted online and [number to be added] comments were received from professionals in the cultural resources field.

This document was the creation of the interdisciplinary Historical Archaeology Research Design (or HARD) team that consisted of (in alphabetical order) consultants from Anthropological Studies Center, Foothill Resources, JRP Historical Consulting LLC, and PAR Environmental Services. At FHWA, Stephanie Stoermer oversaw the first efforts to establish this research design and Gary Sweeten continued to provide management perspective. At the OHP, Deputy SHPO Steve Mikesell has been involved from the project's inception and project review

unit staff members have provided input throughout the process, specifically Michael McGuirt participated in the initial development of this document. The study was prepared under the overall direction of Greg King, Chief of the Caltrans Cultural and Community Studies Office. Project manager was Anmarie Medin, Senior Environmental Planner. Caltrans facilitated peer review by historians and historical archaeologists; Kimberly Wooten compiled the reviews of Steven Mulqueen of the California State Lands Commission, Margaret Hangan of the Cleveland National Forest, and Caltrans staff Dicken Everson, Blossom Hamusek, Julia Huddleson, Greg King, Richard Levy, Anmarie Medin, Steve Ptomey, Dana Supernowicz, Karen Swope, Judy Tordoff, Tom Wheeler, and herself.

The principal authors of this volume are (in alphabetical order) Julia G. Costello, Rand F. Herbert, and Mark D. Selverston, with contributions by Judith D. Tordoff. Shawn Reim, research assistant at JRP, provided valuable assistance in preparing the review of recent articles on mining related topics.

The National Register Evaluation Process under Criterion D

To be eligible for listing in the NRHP, a mining property must be significant in American history, architecture, engineering, or culture and possess integrity of location, design, materials, workmanship, feeling, and association. In addition, the mining property must meet one or more of the four National Register criteria:

A. be associated with events that have made a significant contribution to the broad patterns of our history; or
B. be associated with the lives of persons significant in our past; or
C. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that posses high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. have yielded, or may be likely to yield, information important in prehistory or history.

All researchers should also carefully consider which of the other NRHP criteria in addition to D might also be applicable to the property they are evaluating. This document specifically addresses how to evaluate mining sites under Criterion D, incorporating five basic steps defined by Little and Seibert (2000:14):

1. Determine its structure, content, and classes of data it may contain.
2. Identify the appropriate historic context by which to evaluate it.
3. Identify important research themes and questions that the data it contains may be able to address.
4. Considering the property's integrity, structure, and content, assess whether the data it contains are of sufficient quality to address these important research issues.
5. Identify the important information that the property is likely to contain.

Archaeological properties are evaluated within an appropriate historic context defined by theme, place, and time period. Chapter 2 of this document presents a historic context for mining sites in California between 1848 and 1940, beginning at the Gold Rush and ending just before World War II. It can provide the basis of a context statement for evaluation but must be supplemented by property-specific research to provide the relevant focus. The National Park Service's (NPS 1996) Revised Thematic Framework, *History in the National Park Service: Themes and Concepts,* offers eight themes and many sub-themes that are useful for developing historic contexts for specific properties. The historic context is linked to an individual property by property types—groupings of individual properties that have shared physical characteristics or associations. Property types are discussed in Chapter 3. To make the connection between specific archaeological resources and the property types identified in the historic context, Donald Hardesty (1988) developed the concept of "feature system:" a cluster of archaeological features that are the products of an identifiable process or activity. This approach focuses the evaluation effort onto historically significant units.

To be eligible to NRHP under Criterion D, a property must both contain information that can contribute to our understanding of some aspect of human history *and* the information must be considered important. Research themes and associated questions that can be applied to specific property types are specified in Chapter 4.

Archaeological facts are not intrinsically valuable; they achieve importance in relation to their ability to advance our understanding of human history. We can define what constitutes important information by reviewing current scholarship in disciplines such as history, geography, anthropology, and archaeology. As change in research orientation is a normal part of social science, important issues are moving targets that must be frequently reassessed. We recommend that historical archaeologists consider both the scientific and humanistic contributions of the discipline as they design and conduct their work. Some questions have definitive answers, such as those designed to gather base-line information about structure, content, and integrity of a property. Some questions will have less conclusive or quantifiable answers, as they are designed to help incrementally reveal large-scale historical and cultural processes significant or important in our history. Individual properties often contribute by illustrating how a diversity of processes played out in specific contexts, deepening our understanding of their effects on Californians in the past.

To be eligible to the NRHP an archaeological site must be able to convey its significance to those for whom it has value. In the case of Criterion D, these are scholars and others who may seek to use the information the site contains. The ability of a property to convey this information is measured by assessing its integrity. The appraisal of integrity accompanies an assessment of significance: significance + integrity = eligibility. This topic is discussed in Chapter 4.

Applying the NRHP criteria for evaluation is a complex undertaking. It requires that researchers follow a set process and understand certain terms of art. The NRHP Bulletin series is an essential reference. Of particular importance are Bulletin 15 *How to Apply the National Register Criteria for Evaluation* (NPS 1991) and Bulletin 36 *Guidelines for Evaluating and Registering Archeological Properties* (Little and Siebert 2000). Bulletin 42 *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties* offers essential information as well (Noble and Spude

1997). All are available online at http://www.cr.nps.gov/nr. Donald Hardesty and Barbara Little's book *Assessing Site Significance: A Guide for Archaeologists and Historians* (2000) offers practical advice and many informative case studies.

The California Register of Historical Resources

The eligibility criteria for the California Register of Historical Resources (CRHR) closely follow those of the NRHP, although some properties that are ineligible to the latter may qualify for the CRHR (Office of Historic Preservation 2001:ii). This series of research designs may be used to help evaluate properties' eligibility to the CRHR for the purposes of CEQA within the requirements of the Register's implementing regulations at CCR Section 4850 et seq.

Using this Document for Section 106 Consultation

Caltrans' ultimate goal in producing this document is to streamline eligibility determination consultations with the SHPO under Section 106. To that end, future researchers are encouraged to cite relevant sections of this document and apply specific research questions that relate to the property being evaluated.

California SHPO staff reviewed the document, commented on its fundamental scope, and believes it to provide useful guidance when assessing information values of mining-oriented historic archaeological sites. However, as with all guidance, the SHPO staff will review individual submittals for appropriate application of research questions contained herein as well as for appropriate application of the recommended methods. The individual researcher must explain how the selected research questions apply to the site being evaluated; that is, what information is contained within the individual site and why it is important. As stated elsewhere in this document, other theoretical orientations, research issues, or individual research questions not discussed herein may be identified as relevant to the site under study. If so, those other items would require an appropriate level of development for SHPO consultation.

CHAPTER 2. HISTORIC CONTEXT

INTRODUCTION

Mining in California experienced classic "boom and bust" periods, although the mining industry has been continually active to a greater or lesser degree after 1848. The span of years defining the "Gold Rush Era" has been a source of discussion among California historians since the late 19th century. In his seminal book, *California Gold: The Beginning of Mining in the Far West* (1947), historian Rodman Paul suggested that the classic Gold Rush period consisted of the years 1848 generally through the 1870s. More recent works, such as the late J.S. Holliday's *The World Rushed In: The California Gold Rush Experience, an Eyewitness Account of a Nation Heading West* (1981) or Susan Lee Johnson's *Roaring Camp: the Social World of the California Gold Rush* (2000) have described the Gold Rush as the decade between 1848 and 1858. That general period, of course, included the beginning of the evolution of mining as an economic endeavor from an individualistic enterprise to an industrial system, with all the attendant changes such an evolution would entail to inter-personal labor and inter-ethnic relations, town development, financial requirements, and other conditions.

The second major period is often described as the post-Gold Rush period, which ran from the end of the rush to the early decades of the 20th century, when mining came of age as a largely industrial pursuit, and as mining spread to regions around the state. Industrialization became increasingly significant as mining moved into large-scale exploitation of quartz veins and deep placer Tertiary gravels exposed by hydraulic mining techniques after the Gold Rush period. This was particularly true between the mid 1870s and 1884, when court- and legislatively-imposed restrictions limited the continuation of hydraulic mining. Both lode mining and hydraulic mining required employment of financial capital and hired labor to be successful. Sites based on these mining methods are often significantly different in scale and complexity compared to the simple placer-mining sites of the earliest years of the rush. Hard rock or lode mining producing ores of all kinds continued throughout the period, responding to the changing economic realities of the late-19th and early-20th centuries. Mining for non-precious metals such as lead, copper, and mercury was more common in the 20th century than during the first half-century of California's statehood, although mercury mining began early on, during the Mexican period and later as an adjunct to the gold-mining industry, and both copper and lead were mined as early as the 1860s. The material remains of industrial or base metals mines—particularly in their surface plants—can be substantially different in type and scale from those of precious metals sites.

Finally, during the Great Depression (1929–1941), a number of major gold mines resumed their operations after a period of limited production in the first decades of the 20th century, and transitory gold miners and refugees from the general economic collapse took up small-scale placer mining in ways that recalled the early days of mining in California. These small operators moved out into isolated areas in forests and deserts, typically on public lands, and undertook mining almost as a subsistence activity. In many ways this type and period of

mining, undertaken by what were often referred to as "snipers," is perhaps the most poorly documented of all; Russell Kaldenberg, archaeologist at Naval Air Weapons Station China Lake, maintains that relatively little is known about desert mining activities (2006, pers. comm.). During this period large mines idled by low gold prices restarted operations with federal gold price regulations. Also, mines extracting industrial metals experienced peaks and lulls during the period, as prices for their commodities fluctuated with the strength of the national economy and demands from national and international markets.

Mining for metals occurs in California in almost all areas of the state except the Central Valley. Gold mining, by far the most common and pervasive generator of mining sites, was undertaken in the Sierra Nevada, Cascades, Siskiyous, Tehachapis, the mountains east of San Diego, and wide areas of the Mojave Desert and its ranges. There was also a small, isolated gold-mining area within the coastal mountains of the Big Sur region. The reason for this is simple: gold and other precious metal ores are typically found in or near hilly or mountainous terrain; the exception is a limited number of deposits or placers found in alluvial areas at the edge of the Great Central Valley. The Central Valley and coastal strip from San Diego to the Oregon border has experienced extensive mining activity, but almost all of it is based around construction materials and industrial minerals rather than metals. Some industrial metals, such as manganese and chromite, were found in the Coast Ranges and elsewhere. The most notable exception, mercury mining, was undertaken primarily in the coastal ranges west of the San Joaquin and Sacramento Valley, but for the most part relatively distant from the coast. A simplified visual representation of the location of mining areas in California can be found on Maps 90 and 91 of the *Historical Atlas of California* (1974), by Warren A. Beck and Ynez D. Haase. A map showing "Locations of past-producing gold and mercury mines in California" is available through MAS/MILS (Minerals Availability System/Mineral Information Location System) database compiled by the former U.S. Department of the Interior Bureau of Mines (USBM), now archived by the USGS (Causey 1998).

THE GOLD RUSH AND MINING

The history of metals mining in California began with the Gold Rush. As noted above, this period is generally considered to be the period between 1848 and roughly 1860, during which time a flood of Argonauts entered California's mining regions, prospected new areas, and eventually spread their activities to neighboring territories. The most enduring image of the Gold Rush is the eager, grizzled prospector kneeling alongside a stream with his pick and pan. This idealized view was relatively limited in chronological and technical scope; that is, mining changed rapidly from an individual endeavor to one based on group effort and, eventually, a labor-and-capital industrial paradigm.

PLACER MINING

The Gold Rush period was dominated by placer mining for gold. It was not until hard rock or deep mining spread that other metals, along with gold, were mined. Placer mining refers to mining for gold that nature has freed from its associated rock and left in the form of nuggets, flakes, grains, or dust. Because this process was associated with erosion caused by water flow, gold found through "placering" was located in streambeds or in deposits left in ancient streambeds. During the Gold Rush period, placer mining was heavily dependent on manual labor and the use of water, so its mining sites are typically found along streams, in river canyons, or in tributary canyons. Typical mining equipment during the period included cradles, long toms, sluice boxes, and hand-held equipment (e.g., pans, picks, and shovels). Among the earliest and most persistent method of placer mining, particularly on a small scale, was through "dry" placer mining, which did not use water in the process. As the years passed, more elaborate methods of placer mining (river mining with dams and water-driven pumps, ditch-fed sluicing systems, booming and other nascent versions of hydraulicking, and sinking drifts into ancient gravels) gradually replaced the miner with his pick and pan.

During this time, miners and prospectors fanned out throughout the Mother Lode, southern Sierra Nevada, Siskiyous, Klamaths, and Tehachapis, and began prospecting in the Mojave Desert. Argonauts explored rivers and tributaries draining the Sierra Nevada and Cascades from the Kern in the south to the Pit and Feather in the north, as well as the major river basins of the northwest coastal mountains, including the Smith, Trinity, and Klamath. Often these areas were subject to minor "rushes" as news of potentially rich strikes leaked out; this was true in the Kern River area and in the Transverse Ranges. The locations of these early mining areas, and the routes established to access them, laid the foundation for much of the town and transportation pattern of development existing in the mining regions today.

Much of what is found at a mining site can be divided into two general categories: remains related to mining processes and remains related to habitation at the mining site. Those related to the mining process (such as shafts, pits, adits, waste rock piles, ponds, tools, mining and milling equipment, structures, foundations, tramways, trails, and roads) are usually the most visually prominent. Remains related to habitations are less so, and commonly consist of small perimeter foundations or structure pads (often with dimensional lumber, nails, window glass,

or brick fragments), remnant landscaping (exotic plantings, walkways), and domestic artifacts such as bottles, cans, ceramics, and personal items (Brereton 1976:286–302).

Understanding the development of mining technology and its requirements for labor and capital are particularly important. Obviously, different periods relied on different technologies or had the advantage of improving on earlier mining equipment. As historian Roselyn Brereton (1976) noted in her article, "Mining Techniques in the California Goldfields during the 1850s," "the story, then, of California mining techniques, is the elaboration of simple methods." Brereton reported that the general concepts had been known for centuries, and were described by the German writer Agricola in 1555 in his work *De Re Metallica*. The placer mining methods used in California were employed by the Spanish in the New World, and by miners in Georgia and North Carolina in the 1820s and 1830s. Not surprisingly, miners from those regions were influential in providing information about mining techniques (largely by example) to the largely inexperienced miners of the early years of the Gold Rush (Brereton 1976, 286–302). These included use of the familiar pan (*batea*), cradle (rocker), long tom, and sluice box. Each was a refinement of the earlier—a cradle handled more auriferous material than did a pan (although a pan was often used as a final step), a long tom was more efficient than a cradle, and a sluice box more efficient (especially when linked in series) than a long tom. Each was eventually also more water- and capital-intensive to develop.

Miners used these relatively simple methods to process surface placer deposits, usually near an available water supply. As the Argonauts learned about placer deposits, they turned to other methods that had more pronounced effects on the landscape. Miners quickly learned that rich placer deposits might be found in the Tertiary gravels left in the bed of ancient rivers in the mountains. Millions of years old, the gravels were the remnant deposits of ancient rivers that had run through the region at angles to the modern streams, and were marooned as the Sierra Nevada's granitic batholith was uplifted and changed the drainage pattern. Getting at these gold-bearing gravels required application of significantly different methods because they were overlaid with non-productive deposits that needed to be removed. The result was development of two different methods: hydraulic mining and drift mining.

The advent of hydraulic mining was among the major improvements to placer mining methods. It was one that had profound effects on California's environment, leaving lasting scars on the earth, debris in the canyons and rivers, and a complex network of canals and ditches that shifted water to mining areas remote from their sources. Water conveyance systems for mines are also described in detail, with recordation methods and registration requirements, in *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures*. (JRP Historical Consulting Services [JRP] and Caltrans 2000). Hydraulicking also required the application of investment capital, and employed the paradigm of industrialism (hired labor, resources and services acquired from other companies, etc.).

Hydraulic miners employed water under great pressure to wash away the overburden, and to run gold-bearing gravels through elaborate systems of sluice boxes. The water cannons most often seen in historic photographs, called monitors, were used to remove the "waste" or overburden; smaller monitors were used to wash the gold-bearing gravels into the mines' sluice systems.

Hydraulic mining's heyday was from the 1860s through the mid-1880s, when one of the nation's first environmental lawsuits led to its strict control and, gradually, to its eventual effective end. The story of its development—the invention of the monitor by Edward E. Matteson, and the perfection of practical water delivery methods by builder and entrepreneur Antoine Chabot—in the early 1850s is an oft-told tale, in which Matteson adapted a canvas hose to use an iron nozzle to more efficiently work his claim, and Chabot made a fortune in developing dam and ditch systems to supply miners with water (May 1970). Its rise led to mining canals feeding mines from Plumas to Tuolumne counties, as well as in the Siskiyous and Trinity mountains. Mining historian C.A. Logan (1981:194) noted, "in 1867, there were 5328 miles of main canals, with probably 800 miles more of branch ditches built at a cost of $15,575,400." The main ditches were typically eight to fifteen feet wide at the top, four to six feet wide at the bottom, and three or more feet deep. Steep hillsides and deep ravines were traversed with wooden flumes and heavy iron pipes 20 to 40 inches in diameter. These systems were often converted to use in the state's irrigation and hydroelectric generating systems after the hydraulic mining era passed (JRP and Caltrans 2000:38–50). One of the most famous hydraulic mining sites has been preserved in the Malakoff Diggings State Historic Park; it represents a large example, but is by no means the only one in the region.

Drift mining, a variant method of exploiting the ancient gravels on high, dry hillsides, involved driving tunnels (drifts) into the gravel beds and then processing the extracted material. It was employed where the overburden was too deep for hydraulicking, or where water was less available. The Foresthill area of Placer County was among the most celebrated drift mining areas, although drift mines appeared throughout the state, including at Hill Diggings in El Dorado County.

The final refinement of placer mining during the period of this study was dredging. Mining historian Clark Spence noted that "gold dredging would apply the mass production of Henry Ford's America to placer deposits, again enabling profitable working of ground heretofore untouchable" (Spence 1980:401–414). Successful dredges are largely a 20th-century invention. Although unsuccessful efforts, particularly along the Yuba River, were made in the 1850s, attempts at early dredging were largely abandoned in California by the 1880s. Dredge mining fields were located low in elevation, typically where rivers or major tributary streams emerged from the mountains, such as around Oroville, Marysville, Folsom, and Merced. Dredges were also employed where large placer fields existed in river canyons, such as along the Klamath and Trinity rivers. The first successful bucket dredges in the United States appeared in Montana at Bannack in 1895. Models began appearing in California in 1897, and by 1898 Wendell I. Hammon began dredging near Oroville. By the first decades of the 20th century dredging became efficient, profitable, and a big business; major investors in dredging companies were among the wealthiest people and corporations in the nation. Later, during the Depression period, dragline or "doodle-bug" dredges came into use. These dredges used a dragline to gain access to gold bearing gravels, rather than the continuous line of buckets on earlier dredges. Dragline systems also had processing equipment separate from the digging mechanisms.

Dredging was less financially risky and more profitable than most forms of mining, because modern methods such as test holes could predict production levels with accuracy. A modern dredge would typically run 18 hours a day, seven days a week, on an industrial schedule. The companies maintained machine shops to keep the massive equipment in repair (Spence 1980:404–414). By 1905 the dredges used a system of revolving screens and shaking tables to separate gold from sand and gravels. According to Logan (1981:194), "since then, this type of dredge has been put on practically every gold-bearing river in Northern California, but the most important fields have been Yuba River near Hammonton, American River near Folsom, and Feather River near Oroville." Placers exploited by the dredges were also the source of most of platinum found in California; early placer miners had discarded the metal as worthless. The dredges in these locations operated into the mid-1960s. He reported that the capacity of a large modern dredge reached 125,000 cubic yards of gravel per year. In 1948, the modern dredge *Yuba No. 20* was 540 ft. long, with a chain of 135 buckets of 18 cubic-ft. capacity each, able to reach gravels 124 ft. below the water line. Yields of 10 to 15 cents of gold per cubic yard were mined at a cost of 5 to 10 cents. The modern dredge operated with a crew of only three or four men per shift. Prior to World War II there were about 200 such dredges in operation (California Division of Mines and Geology [CDM] 1950:343; Spence 1980:401–414; Logan 1981:194). To put the size of massive dredgers like *Yuba No. 20* in perspective, it was more than half the length of the famed ocean liner *Queen Mary*.

Such machines caused substantial damage to the environment. Mining historian Spence noted that the tailing piles in long rows were the signatures of the industry. He also observed that, because their operation was largely before the era of environmental regulation and its wastes tended to be confined within the mining claim, the industry largely escaped serious regulation. These tailing piles were often mostly sterile gravels and cobbles on which vegetation was slow to grow; requirements for "resoiling" were defeated in court and largely ineffective when attempted (Spence 1980:401–414). When dredging stopped in California, the available dredging equipment was largely disassembled and shipped to other gold fields around the world.

LODE/DEEP MINING

Miners during the Gold Rush were quick to realize that gold existed in quartz veins, and attempted to mine it. As early as 1849, famed guide and trailblazer Kit Carson discovered the Mariposa Mine with its ore-bearing quartz. Early miners used arrastras and other simple mechanisms to try to release the gold from the rock in which it was found. Thad M. Van Bueren's recent and valuable article, "The 'Poor Man's Mill': A Rich Vernacular Legacy," in *IA, the Journal for the Society of Industrial Archeology*, provides a comprehensive history of the types of arrastras used in California and the west, how they were constructed and used, and their persistence through time (Van Bueren 2004).

Lode mining had six specific requirements that were lacking in simple placer mining. First, it required technical engineering expertise to design and build the physical plant for such a mine, both above and below ground. While at first the basics of this knowledge were often self-

taught, as the years went on specialized technical expertise became more and more critical. Second, processing the ore involved the application of heavy equipment coupled with motive power. Ores had to be crushed to release their gold. Miners generated power for the crushers and for mining equipment by using high pressure water wheels, and later, electricity. Third, the ore often required chemical treatment, through the application of mercury, acids, cyanide, and other solutions, to release the gold from the compounds in which it was found. Fourth, these mines, particularly the larger examples, needed hired labor to operate; of course, this meant that the mine needed to meet payrolls no matter what the day-to-day yield of the veins brought the company. Fifth, as the years progressed, mining geologists became a requirement at major mines. Finally, the need for technical expertise, heavy equipment, chemical plants, and labor meant that mine owners needed ready access to financial markets and investors to fund development and operations. Investors needed surety that a mine's claims were valid, and that its veins had potential yields to provide return on investment (Paul 1947, see Chapters X, XIII, XIV, XV, XVI, XVII). As mining historian Rodman Paul put it,

> Mining had started as an adventure in which men engaged with little capital and less knowledge. Gradually it had become a business conducted upon the basis of common sense rules that had been learned through practical experimentation. Now [Paul was discussing the early 1870s] it was being transformed into a modern industry in which the dominant figure was not the "honest miner" who dwelt in the Sierra's foothills, but rather the financier in San Francisco or London, and the highly paid consultant or superintendent who made of mining a science and a profession.
>
> With the attainment of that stage, the industrial revolution was complete. Then truly it could be said that mining had come into its full development— that it had passed from the disorganized splendor of its youth to the ordered stability of its maturity [1947:310].

Lode development did not experience a smooth upward path. By 1858 there were more than 280 stamp mills, each supplied by one or more veins. By 1861 only 40 to 50 were still in operation. Numbers fluctuated in the years that followed. Hand drills and black powder were common up to 1868, when miners and mining companies began converting to advancements such as power drills and nitroglycerine-base dynamite. It took decades before these became common. Rock crushers, like the Blake Crusher, were introduced in 1861. As mining historian C.A. Logan remarked, "the self-feeder, the rock breaker, heavier stamps, and increased running speed gave the stamps greatly increased capacity" (Logan 1981:195–196). Likewise, ore concentration methods became more technologically advanced as the years progressed. By the 1880s the Frue vanner and endless rubber belt vanners more efficiently concentrated the stamp mills' output, along with mercury tables, and other equipment. The development of chemical processes such as chlorination, used in conjunction with such concentrators, increased the plants' efficiency further. Chlorination was predominantly used until 1896, when the cyanide process came into the industry (Logan 1981:195–196). Manufacturers in California and, after the completion of the transcontinental railroad, in eastern manufacturing centers, provided the machinery and equipment used at the mines. Historian Lynn R. Bailey's (1996) valuable work, *Supplying the Mining World: The Mining Equipment Manufacturers of San Francisco, 1850-1900*, is a valuable source for understanding not only the context of mining equipment manufacturing,

but also the companies and the kinds of equipment provided. Naturally, the more complicated the mining equipment on site, the more necessary were technically adept mechanics and operators to keep them running.

An understanding of the processes and equipment used in mining and ore beneficiation is important in assessing a site, although it is an extremely rare occasion when a survey includes a mine complete with equipment. Miners rarely left behind valuable items when they vacated a mining site, particularly because they would be useful at the next strike. In the 1930s and 1940s, at those idle mines located near enough to decent roads, abandoned machinery or other equipment (such as rails and ore cars) often fell prey to the scrap collectors who scoured the mining areas, or was otherwise appropriated, first for sale overseas, and later, for the war effort. The USBM *Minerals Yearbook* for 1940 indicates that iron and steel scrap (from all sources, prepared and unprepared) on hand in California in 1939 totaled 140,997 tons; in 1940 it had dropped to 86,733 tons. While these numbers are statewide figures, and are not segregated as to source, they do indicate the magnitude of the scrap iron and steel industry in the state (USBM 1941:506).

LAWS RELATED TO MINING AND WATER CLAIMS

The rapid and unplanned development of mining in California resulted in, at least for a time, a relatively *ad hoc* set of laws and rules for how claims, mines, and water rights were to be administered. Because gold mining began even before California was ceded by Mexico in the Treaty of Guadalupe Hidalgo (gold was discovered in January 1848, the treaty was negotiated and signed in February 1848 and proclaimed on July 4, 1848), the military authorities then governing California allowed mining on public land to begin and continue unhindered by federal regulation. Obviously, prior to the establishment of state government and counties, official local regulation of mining and use of water essentially did not exist. A handy, if somewhat dated, work on this topic is John F. Davis's (1902), *Historical Sketch of the Mining Law in California*. Miners sought order, and imposed it through unofficial means by establishing mining districts, each with its own set of rules. While they differed in many ways, many had common features. Charles Howard Shinn's (1885) *Mining Camps: a Study in American Frontier Government* provides an analysis of the origins and types of mining camp governments established by the Argonauts. Of course, as statehood established local governments and clearer rules, and as the federal government considered how to administer claims on the public domain, the rules became clearer. The federal Mining Act of 1866 replaced the older system of "tacit consent" whereby federal authorities allowed for mining with minimal regulation. Justice Stephen J. Field, himself a Californian and Argonaut, in his opinion in *Jennison v. Kirk* (98 U.S. 453), explained the situation:

> The lands in which the precious metals were found belonged to the United States, and were unsurveyed and not open by law to occupation and settlement. Little was known of them further than that they were situated in the Sierra Nevada mountains. Into these mountains the emigrants in vast numbers penetrated, occupying the ravines, gulches and canyons and probing the earth in all directions for the precious metals. Wherever they went they carried with them the love of order and system of

> fair dealing which are the prominent characteristics of our people. In every district which they occupied they framed certain rules for their government, by which the extent of ground they could severally hold for mining was designated, their possessory right to such ground secured and enforced, and contests between them either avoided or determined. These rules bore a marked similarity, varying in the several districts only according to the extent and character of the mines; distinct provision being made for different kinds of mining, such as placer mining, quartz mining, and mining in drifts or tunnels. They all recognized *discovery*, followed by appropriation, as the foundation of the possessor's title, and development by working as the condition of its retention. And they were so framed as to secure to all comers within practicable limits absolute equality of right and privilege in working the mines … Nothing but such equality would have been tolerated by these miners, who were emphatically the law-makers, as respects mining upon the public lands in the State. The first appropriator was everywhere held to have, within certain well-defined limits, a better right than others to the claims taken up; and in all controversies, except as against the government, he was regarded as the original owner, from whom title was to be traced … For eighteen years, from 1848 to 1866, the regulations and customs of the miners, as enforced and moulded by the Courts and sanctioned by the legislation of the State, constituted the law governing property in mines and in water on the public mineral lands [Davis 1902:15–16].

In his *Historical Sketch of the Mining Law in California* (1902), John F. Davis noted that the legal scholars had differed on the origins of these concepts, some ascribing them to Mexican tradition (especially the importance of discovery and use), others have pointed to Cornish, Southern, or South American practices. All of these traditions seem to have included aspects of the mining laws that developed in California and the West. Davis observed, "may it not be simply another illustration of the fact that, with the same problem and the same environment, the human mind has in different ages often arrived at the same practical solution." By 1867 there were more than 500 mining districts in California (Davis 1902:17–20).

Because miners could not own the land, their claims were supported by boundary demarcations, evidence of consistent work, and rules related to periods of occupancy. Miners who did not work their claims, left them unmarked, or were absent from them for long periods, often found them seized by others. Poorly demarked claims were subject to conflicts among neighboring claimants. This concept—that claim, development, and consistent use was the measure of a right—carried over into the federal rules governing mining on the public domain after 1866. Prospectors would stake their claim, file a plat with the land office and local county, and then "prove up" by showing development and use. If a sufficient showing was made, the federal government would issue a patent for the claim. Perhaps unsurprisingly, this process is similar in important ways to the prior appropriation concept that forms the basis of one important kind of water right in California. Deep industrial mines for all metals also fell under the so-called "Law of the Apex," which established a complicated system for apportioning ownership and control over lode claims based on which claim owned the "apex" (i.e., highest point) of the vein. While it cleared up a persistent problem in contests between claimants, the process of determining who held the apex engendered lawsuits; in fact, legal historian Davis noted that virtually all valuable mines were forced to defend themselves in court against

counter-claimants. This factor added extra value to those companies who had the means to employ expert mining geologists and engineers who could help defend claims in court. It also resulted in careful designation of mining claims and their boundaries (Davis 1902:49–58, 61–75).

Understanding the process for claiming mining sites has a practical value for cultural resource survey teams and archival researchers. It can help inform the researcher as to early ownership patterns and identify persons involved, and can assist the field archeological team in understanding the spatial relationships among evidence found on the ground, particularly in early placer mining sites. It also helps us understand why sites are so often obliterated or overlaid by later workings. Mining claims may have had a succession of owners, or have been subject to consolidation as the mining techniques in an area became more elaborate and extensive. An area covered by a number of simple, early placer claims may have later been subject to dredging or hydraulicking, once consolidation of claims was sufficient to merit employment of more intensive and modern methods.

As noted above the Gold-Rush-Era miners' concepts of claims being based on discovery and development/use (sometimes shortened to the catch-phrase "use it or lose it") extended to the complicated world of water rights. In particular, placer mining sites located at a distance from water sources needed a means to bring water to their mines; competing water diversions among miners or ditch companies often led to legal wrangles. Perhaps naturally, the miners established a similar system of establishing water rights based on claim and development. Diverters filed claims with county recorders setting forth their points of diversion and amounts of flow; the date of the claim established a priority ranking in time. The original state constitution did not recognize this system, but the requirements for water in mining led to its adoption through statute. Sources related to the history of the development of water rights laws in California and the West are legion. Important works include Robert Dunbar's *Forging New Rights in Western Waters* (1983) which provides an overview of water rights laws in the western states, including California. Douglas R. Littlefield's (1983) article, "Water Rights during the California Gold Rush: Conflicts over Economic Points of View" in the *Western Historical Society Quarterly* summarizes the legal situation during the Gold Rush. Donald J. Pisani also addresses the interrelationship of mining and water law in *Water, Land, and Law in the West: the Limits of Public Policy, 1850–1920* (1996), providing two case studies of water law development in California mining camps. Of course, it is this same concept—of claim, development, and use—that is used by farmers, irrigation districts, and municipal systems to establish their rights to water today.

For the purposes of this study, what is important is that diverters generally kept careful records of claims, providing researchers with important clues related to when diversions to mining sites were planned, and by whom. In addition, the frequent legal contests over water rights have left a rich record in superior court files of the various counties (or, if appealed, in the case files of the California Supreme Court). These can contain such items as sworn testimony as to diversion and use, filings setting forth statements of fact related to the case, and trial exhibits such as maps, plans, and other valuable information.

ETHNICITY/RACE/GENDER

In recent years many mining scholars have focused their attention on the issues of ethnicity, race, and gender in the mining industry. During the early years of the Gold Rush, for example, Native Americans constituted a substantial percentage of the total number of miners, and acted both as paid labor and mine owners. Historian James Rawls showed that Native Americans constituted more than one half of miners in California in 1848. While most were employed as workers, some mined independently. Independent Native American miners usually traded their gold for manufactured goods and food. That Native Americans did not place the same value on gold as whites did became a source of unfair advantage to whites, who often sold badly damaged goods for large sums of gold. As Native American miners came to understand the value of gold, however, they became more effective traders and became more demanding in their dealings. Independent Native American miners virtually disappeared by the 1850s because of the shift in mining from placer to hydraulic and quartz mining which did not favor the employment of Indian labor (Rawls 1976:28–45).

It is a well-known story that miners from around the world poured into California during the Gold Rush and the years that followed; it is not the intention of this essay to detail the arrival and role of various ethnic or racial groups. Rather, what is important is the fact that U.S. citizens, while comprising a majority of the Argonauts, were not the only or even the first immigrants. Sonorans, Chileans, and Hawaiians were among the first to arrive, followed by the French, British, Australians, Chinese, Croatians, Italians, Cornish, Germans, Jews from various countries, and others, who with Americans joined the migration to the California gold fields. Among the throngs were women, both U.S. citizens and a variety of other nationalities. African-Americans (free and slave) formed another important, but relatively small, group. Non-American miners were subject to official discrimination through imposition of the Foreign Miners' Tax of 1850. While written to apply to all non-citizen miners, it was unequally enforced and focused primarily on Asian and Hispanic miners, and used to drive them from the mines. Of course, discrimination was also an occurrence outside of the official realm; white American miners might ignore the British or Australians, focusing their antipathy instead on Mexicans, Sonorans, Chileans, African-Americans, and Chinese. See the recent historiography in Chapter IV for a discussion of scholarship related to ethnic groups, race relations, and gender issues during the Gold Rush and industrial mining periods.

It is a commonplace that women were a minority in California during the Gold Rush, and that it took several decades for the population to reach a more normal gender balance. Women did come, however: wives and daughters accompanied husbands and fathers, and single women came in search of their fortunes. In *A Mine of Her Own,* Sally Zanjani (1997) chronicles activities of women miners in the American West. Susan Johnson (2000), in *Roaring Camp*, maintained that virtually every hotel, saloon, dancehall, or restaurant in the Southern Mines had a French woman as an owner or employee. JoAnn Levy (1988), in her *Overland Journal* article "We Were Forty-Niners Too! Women in the California Gold Rush," pointed out that it has often been thought that women were virtually non-existent in the gold fields during the Gold Rush. Levy showed there were, in fact, many women who were Argonauts, and they traveled in great numbers (though fewer than men) to California in search of gold and other

ways of making money. Women did a little of everything, including cooking, washing and laundry, running boardinghouses, mining, prostitution, and were shopkeepers. Levy highlighted the determination and adventurous spirit of these travelers and briefly outlined their priorities. For those arriving with dependents, women sought first to care for their families on the journey, then to build a home, and finally to make money. They had countless entrepreneurial opportunities during the Gold Rush and found they were justly compensated for their efforts. Cooking, washing and mending, running a boarding house or restaurant were often their primary pursuits, but it was also common that they owned businesses such as theaters, barber shops, photography studios or mercantile establishments. Only about one in five women were prostitutes; and these were drawn to it for economic reasons, rather than the common misconception they were forced or tricked into it (Levy 1988:29–34).

The Chinese were another of the most important groups who came to California during and after the Gold Rush. Competition with white miners often led to efforts to remove the Chinese from their mining claims. These began in earnest in 1852 and continued through the end of the 19th century (DuFault 1959:155–170). The Chinese were drawn to California not only by gold, but in reaction to the travail of 13 years of civil war in China. Soon there were more than 30,000 Chinese in California who had taken the six week-long voyage across the Pacific. More followed, and Chinese miners spread throughout California, Nevada, Oregon and Washington, usually traveling in groups. This was an advantage when staking and working claims. Historian Liping Zhu (1999) reported that the advent of hard-rock mining, and the Chinese Exclusion Act, forced many Chinese out of mining. Mining historian Randall Rohe showed that foreign men replaced American miners after the initial rush, and in placer mining areas, the replacement miners were usually Chinese, who played an important role on the frontier. Chinese miners, according to Rohe, complemented white miners and slowed population decline in mining areas abandoned by others, spent a large portion of the gold they found in their local economies, and paid their share of taxes (Rohe 1982:2–19).

POST-GOLD-RUSH INDUSTRIAL MATURITY: DIVERSIFICATION OF TARGET METALS AND MINERALS

The end of the Gold Rush, as noted above, was marked by the transition to more capital- and labor-intensive mining. This was true in hydraulicking, as well as the later innovation of dredging that became one of the more important producers of gold in the state. The deep lode mines of the 19th and early 20th century built on technological innovations, such as compressed air tools, electrical power, and improved beneficiation methods to expand and industrialize mining for both precious and base metals alike. In the 1890s and in the decades that followed, deep-lode mining was the subject of great technological improvement, both in mining and beneficiation methods. These made lower-grade ores more economical to exploit. Mining historian William Clark noted that "the improvement of air drills, explosives, and pumps, and the introduction of electric power lowered mining costs greatly." He added, "...the introduction of rock crushers, increase in size of stamp mills, and new concentrating devices, such as vanners, lowered milling costs." New chemical methods, such as the cyanide process mentioned above, had similar effects and replaced chlorination (Clark 1970:7).

While the target metal may have differed, many of the above-ground manifestations of industrial metal mining sites are very similar to gold and silver mines in appearance. Of course, where beneficiation equipment (or sites where such equipment once stood) is extant, important differences can occur. For example, the surface plant at a mercury mine is far different than that of a stamp mill at a gold mine, although the shaft, headframes, and equipment used to move ores from the mine to the mill may be very similar.

Between 1916 and 1929 the state's general prosperity led to a reduction in gold output, which only began rising again after the onset of the Great Depression, when operating costs declined. Between 1933 and 1935 the price of gold rose from $20.67 to $35.00 per ounce, which in turn led to increased exploration and output. As shown in Table 1 below, by 1940 the state's output reached $51 million. Clark noted, "...this was the most valuable annual output since 1856. Thousands of miners were employed in the quartz mines at Grass Valley, Alleghany, Nevada City, Jackson, Sutter Creek, Jamestown, Mojave, and French Gulch. There were many active bucket line dredges, and dragline dredges became important producers of placer gold" (Clark 1970:8). The fluctuations can be seen in Table 1.

Table 1. Gold Production in California 1850–1940.
(Five-year intervals; dollar values standardized)

Year	Fine Ounces	Value in Constant Dollars
1850	1,996,586	41,273,106.00
1855	2,684,106	55,845,395.00
1860	2,133,104	44,095,163.00
1865	867,405	17,930,858.00
1870	844,537	17,458,133.00
1875	816,377	16,876,009.00
1880	968,986	20,030,761.00
1885	612,478	12,661,044.00
1890	595,486	12,309,793.00
1895	741,798	15,334,317.00
1900	767,390	15,863,355.00
1905	914,217	18,898,545.00
1910	953,734	19,715,440.00
1915	1,085,646	22,442,296.00
1920	692,297	14,311,043.00
1925	632,035	13,065,330.00
1930	457,200	9,451,169.00
1935	890,430	31,165,050.00
1940	1,455,671	50,948,585.00

Source: data from Clark (1970:4)

Gold and Silver

In the 1910s through the 1930s, mining, particularly for gold, and silver (and to an extent, for copper, lead and zinc) followed a pattern of expansion and contraction, although throughout most of the period industrialists and entrepreneurs continued their efforts. Relatively few historical works focus on the period; information for metals production, in particular, must be gleaned from state and federal reports. The USBM, for example, tracked production from placer and lode mines producing all five metals and provided statistics for the years 1903 – 1940, and its chapter in their annual *Minerals Yearbook, Review of 1940* focused on gold, silver, copper, lead, and zinc in California. Some examples of yearly activity between 1910 and 1940 illustrate the ups and downs of the industry (Table 2).

Table 2. Placer Gold Mining, Number of Mines in Example Years

Type of Mine	1910	1920	1930	1935	1940
Placer dredging (shown mines/ plants) (all kinds)	41 / 72	25 / 41	21 / 31	99 / 114	363 / 259
Hydraulic	168	51	79	93	92
Small surface placers (wet)	184	61	688	1,132	282
Small surface placers (dry)	1	1	6	21	17
Drift	139	45	88	143	96

Source: data from USBM (1941:219–222)

The substantial increase in small surface placer mining in 1930 and 1935 reflects the return of a number of small-scale operators to the industry during the Depression; as the economy began shifting to war footing, many of these miners apparently abandoned their operations for occupations elsewhere. The bureau did not provide a similar breakdown for lode mining over the same period. In the accompanying tables, the bureau's authors noted that figures excluded "itinerant prospectors, snipers, high-graders, and others who gave no evidence to legal right to property" (USBM 1941:218). As noted above, such "snipers" were common in the desert and on private and public lands (national forests, etc.) in the Sierra foothills, largely acting illegally as subsistence miners eking out a living from small mines, and are poorly documented.

What was most impressive, however, was the extent of mining being undertaken in California at the end the period covered by this study. Relatively few active gold mines exist within the state today, but in 1940 there were more than 1,866, some types of which are shown in Table 2. There were 1,030 lode mines. The bureau noted, "the total value of the gold, silver, copper, lead and zinc recovered from ores, old tailings, and gravels in California in 1940—$54,268,690—was greater than in any year since 1856; the increase over 1939, however, was only $1,350,678 or three percent. Most of the increase was due to the advance in gold and copper production." Nine counties out of the 44 that produced one or more of the metals represented the bulk of the total (Table 3).

The single best producer of copper at this time was the Walker Mine in Plumas County, which milled 437,450 tons of ore and produced 10,524,345 pounds of copper, along with 14,176 ounces of gold and 237,891 ounces of silver (USBM 1941:251). The gold and silver found in conjunction with the copper often provided the profit for the mining company, while the production and sale of copper simply met its mining expenses.

The state did not collect statistics for silver mining in California until 1888, but in the years between 1888 and 1950 the state produced 100 million ounces of the metal, which represented 2.8% of the national total to that time. As noted, silver was most often found with other metals; only a few mines, such as those at Calico (1882–1895) and Randsburg (1895), had silver as the principal ore. Prospecting for silver began in earnest after the Comstock discovery in Nevada, and silver mines were found in Alpine, Mono and Inyo counties after 1861. Cerro Gordo and

Darwin in Inyo County, and Calico in San Bernardino County remained active silver mining areas (CDM 1950:343–347).

Table 3. Important Gold/Precious Metals Mining Counties

Nevada County	21% of the state's total output of gold, silver, copper, lead and zinc; the county accounted for 22% of the state's total gold production, and 40% of gold produced from the state's lode mines
Sacramento County	10% of the total, largely from gold dredging
Yuba County	7% of the total, largely from gold dredging
Amador County	8%, two thirds from ore and one third from placers
Calaveras County	6% two thirds from ore and one third from placers
Plumas County	5% of the total, mostly from gold and copper ores
Butte County	5%, production was largely from placer gravels
Siskiyou County	4%, production was largely from placer gravels

Source: data from USBM (1941:217–225)

Industrial Metals of the 19th and 20th Centuries

Scholars examining the history of mining in California have focused, perhaps not surprisingly, on mining of precious metals (i.e., gold, silver); these represented the greatest economic value and generated the most excitement at the time. It was the lure of riches that drew the Argonauts during the Gold Rush, and it was the search for gold and silver that led prospectors to fan out across the state, and the west, to seek new mining areas. In a way, the search for gold, and to a lesser extent silver mining, captured the collective imagination of historians as well as of miners. Of course, a wide variety of metals have been mined in California between 1848 and 1940; some, like mercury (quicksilver) were used at first primarily in the gold-mining industry. Others, like lead, copper, zinc, tungsten, manganese, molybdenum, and antimony were industrial metals; these too were often found in association with gold and silver. The following discussion provides an overview of the location and history of exploitation of these industrial metals.

Mercury

Although mercury mining in California predates the Gold Rush, the emergence of the industry was nevertheless closely tied to the discovery of gold in California. Spanish settlers near San Jose were aware of mercury sulfide (more commonly known as cinnabar) deposits in the local hills in the 1820s. Large-scale mining for the ore in the area, however, did not begin until 1846. The New Almaden Mine opened that year, and from 1850 to 1870 it was the principal producer of mercury for both the state and the nation. New Almaden yielded 535,437 flasks (the flask being the standard unit of mercury measurement, roughly equal to 76 pounds) over this twenty-year period (Ransome and Kellogg 1939:359, 361).

The discovery of gold in 1848 and the ensuing rush to prospect California precipitated a demand for mercury that propelled production of the element until the early 1880s. Prior to the

early-20th century, mercury was crucial to the extraction of gold in the United States. Most metals adhere to mercury through a process known as "amalgamation." Employing this physical principle, miners would pass gold ore down a trough coated with mercury, or otherwise mix the gold bearing "pulp" with mercury. Any gold in the ore would then bind with the mercury, forming a gold-mercury amalgam. Miners would scrape off the mercury and separate it from the amalgam, usually through a retort to distill off the mercury, yielding higher purity gold concentrates. Residual mercury from this process was often released into the environment, deposited in the earth, in streams, rivers, or lakes, contributing to a significant amount of environmental pollution that only worsened with the onset of hydraulic mining. Mercury pollution from the Gold Rush persists into the present (Alpers and Hunerlach 2000:1–6).

In the late 1840s and early 1850s, the demand for mercury in this amalgamation process led to the opening of a number of mines. In 1854, the New Indria Mine located in San Benito County began production, and soon rivaled the New Almaden Mine in volume. Further mercury discoveries were concentrated in Napa, Sonoma, Colusa, and Lake Counties, areas of volcanic activity in which mercury commonly proliferates. The St. Johns, Aetna, and Guadalupe mines were all opened in this period; however, only the latter produced any mercury prior to the 1860s (Ransome and Kellogg 1939:359). Other cinnabar mines were located in Death Valley (Swope 1999).

The shift to hydraulic mining and the discovery of the Comstock Lode in the late 1850s further stimulated mercury production in the state as gold mining companies sought to maximize the extraction of gold ore. From roughly 1860 to 1870 a number of mines rich in mercury opened. The Knoxville and Manhattan mines both began production, as did the Manzanita Mine and a number of other smaller properties in and around Sulphur Creek and Wilbur Springs in Lake and Colusa counties. Cinnabar was discovered near Santa Barbara and San Luis Obispo as well, deposits that prompted the opening of the Oceanic and Klau mines (Ransome and Kellogg 1939:359–360).

The 1870s was the most significant era for mercury mining in California history. During this decade, the state produced a third of the world's mercury (Isenberg 2005:48). Of all California's mercury regions, the Mayacmas district—an area that encompasses much of the mountainous and volcanic areas of Lake, Napa, and Sonoma counties—was the single most important. Within the Mayacmas district, several new mines joined those already in production, including the Great Western, the Culver-Baer, the Cloverdale, and the Oat Hill. Existing district properties, such as the Knoxville, the Guadalupe, the St. Johns, Aetna, and the Altoona mines all reached record highs of production (Ransome and Kellogg 1939:359–360).

While mercury production remained an important component of geological economy of California into the mid-20th century—particularly with the onset of the Second World War—the industry as a whole largely stagnated from the 1880s onward. Gold beneficiation processes in the U.S. moved away from amalgamation, and although mercury remained important to a number of technological and medical devices, demand was easily met by existing reserves and by overseas production (CDM 1950:335; American Institute of Mining and Metallurgical Engineers 1953:325–332). After 1878, only two notable mercury discoveries were made in the

state: the Mirabel Mine in 1887 and the Corona Mine in 1895 (Ransome and Kellogg 1939:360). In 1965, only 25 years after the end of the period addressed by this study, California produced a paltry 13,404 flasks, a stark contrast to the production of just the New Almaden Mine a century earlier (USBM 1967:134).

Other Industrial Metals

Besides mercury, California mines produced metals used in industrial processes or for industrial purposes, especially those that developed in the late-19th and early-20th century. For example, tungsten became the metal of choice for use in electric light bulbs in the 20th century; its high melting point made it valuable in producing hard and sharp steel tools for machining steel and other metals, and as a hardening alloy in steel. The need for tungsten was particularly acute during wartime (CDM 1950:355–361).

Some industrial metals had relatively short periods of production during which limited amounts were mined. Antimony appears in a variety of locations in California, and was mined as early as 1887. More than half of the state's production occurred during WWI. Antimony mines were located in Kern and Inyo counties, the most productive of which was the Wildrose Mine in Wildrose Canyon, Inyo County, which was most active during 1915–1917. Other mines of note were in Kern County, including the San Emigdio Mine, which produced both antimony and silver (CDM 1950:288–291). Bismuth, used in medical and cosmetic preparations and in alloys with cadmium, zinc and lead, was also produced in limited amounts. The Lost Horse Copper Mine in Riverside County, for example, yielded 20 tons of bismuth in 1904. Later production came from the lead mines in the Darwin District of Inyo County. The state's entire production of cadmium was obtained as a by-product of smelting copper-zinc ores in Shasta County in 1917–1918 (CDM 1950:291–293).

Copper. Copper mining began in California in 1860 in Calaveras County, when Hiram Hughes located the deposit developed as the Napoleon Mine near what became Copperopolis. Miners in the area had been discarding valuable copper ore as a nuisance in their search for gold; Hughes had it assayed and learned its value was $120 per ton. Over the next 90 years more than 600,000 tons of copper were produced by the state's mines and smelters. While this production was small in comparison to that of states with major copper mines (such as Arizona and Montana), copper ranked second only to gold in terms of its value as a metal. Between 1897 and 1930, an average of 16,000 tons per year was produced. Output dropped between 1931 and 1936, owing to a decline in the price of copper. Most of the production came from Shasta, Plumas, and Sierra foothill counties. By the end of 1946, 54 percent of the state's production had come from Shasta County, while 26 percent came from Plumas County, and 12 percent from the Sierra foothill counties (of which Calaveras produced more than 80% of the total). The Iron Mountain Mine in Shasta County alone accounted for 42 percent of the state's total production, while the Walker and Engels mines in Plumas County and the Penn, and Keystone-Union in Calaveras County produced 37 percent. All the other copper mines in the state represented 21 percent of production. The California Division of Mines reported in 1950 that "only eight counties in the state have no recorded copper production; these are Kings, San Francisco, San Joaquin, San Mateo, Santa Cruz, Solano, Sutter, and Yolo." (CDM 1950, 300–307).

Besides those mentioned above, 26 other mines produced significant amounts of copper. Major copper mines in the state and their county locations are found in Table 4.

Table 4. Important Copper Mines in California.

Major Mine	County
Iron Mountain	Shasta
Walker and Engelss	Plumas
Penn and Keystone	Calaveras
Other Significant Mines	
Copper Hill, Newton	Amador
Big Bend	Butte
Napoleon, North Keystone, Quail Hill	Calaveras
Copper King, Fresno	Fresno
Pine Creek	Inyo
Daulton	Madera
Spenceville	Nevada
Dairy Farm, Valley View	Placer
Superior	Plumas
Copper World	San Bernardino
Afterthought, Balaklala, Bully Hill, Hornet, Keystone, Rising Star, Shasta King, Sutro	Shasta
Blue Ledge, Gray Eagle	Siskiyou
Island Mountain	Trinity

Not surprisingly, the counties listed are among the most active mining counties in the state (CDM 1950:302). A smelter was built in Contra Costa County in 1862, and by 1868 there were nine smelters operating in the Sierra foothills. Falling prices for copper led to a period of inactivity in the copper industry until the mid-1890s, when the industry began to recover. Iron Mountain Mine in Shasta County resumed operations, and erected a smelter near Keswick which operated until 1907, when the company built its major smelter at Selby, near Martinez in Contra Costa County. During the first years of the century other mines, like the Afterthought, Balaklala, Bully Hill, and Mammoth built smaller smelters on site. Problems with high levels of zinc in the ores, and with pollution law suits, led to the Shasta mines being idled by 1919, and in the years that followed there was only sporadic activity. According to the California Division of Mines, California's copper deposits were mined by familiar underground methods, and the ores required fine grinding and use of flotation to form concentrates suitable for sending to the smelters (CDM 1950:305, 307).

Zinc. Zinc in California came from two major sources: lead and silver mines in the eastern California deserts, and as a by-product of the copper mines in the Sierra foothills and Shasta County. The first recorded production was in 1906, and between then and 1950 some 186 million pounds were produced, half of which came between the World Wars, a period of high

zinc prices. Between 1928 and 1943, virtually all of California's zinc production came from mines in the desert, as copper mining largely ceased in the rest of the state (CDM 1950:364–367).

Lead. Lead was another of the more important industrial metals. By 1950 (ten years after the period studied by this report), mines in California had produced 300 million pounds of lead. Inyo County was the center of lead production, from three districts: Cerro Gordo, Tecopa, and Darwin. Darwin and Cerro Gordo were located in the Inyo Range east of Lone Pine, while Tecopa was in the Nopa Range of southeast Inyo County. Lead was mined using standard underground methods, and was first produced by Mormon miners working silver deposits in the Panamint Range in 1859. The mines at Cerro Gordo were discovered and worked on a small scale by Mexican miners starting in 1862. The California Division of Mines reported that "American interests" took over these mines in 1869, and increased production. They erected a smelter at Cerro Gordo and another at Swansea, on the eastern shore of Owens Lake. The mill and smelter site at Swansea is California Historic Landmark No. 752, the site of a mill and furnace that produced silver bars. Cerro Gordo's mines were substantially worked out by 1877, but interest revived after a railroad reached Keeler, just south of Swansea, and the mines were worked intermittently thereafter. Mines of the Cerro Gordo district produced more than $17 million in lead, silver and zinc. Prospectors discovered deposits in Darwin in the 1870s, and before 1880 some small mills and smelters were in operation. The town reached a population of 5,000, but price fluctuations and its relative isolation led to only intermittent production until World War I. After the war, mining ceased, resuming again only in World War II (CDM 1950:323).

Alloy Metals. California mines also contributed large amounts of metals that serve primarily as alloying agents, mostly in steel. For example, chromite was produced in significant amounts. It was first mined in 1868, and during 1869–1889 some 1,500 to 2,000 tons of ore were obtained each year from mines in Del Norte County, as well as from smaller deposits in San Luis Obispo, Placer, Sonoma and Lake counties. The California Division of Mines reported that there were 1,200 deposits in the state, of which 46 had shipped at least 1,000 tons of ore each. At this time the mines were in the Sierra foothills and the Klamath Mountains, as well as a scattering in the Coast Range from San Luis Obispo to Tehama counties. Between 1921 and 1941, the state averaged only 500 tons of ore per year (CDM 1950:297–298).

Other metals, such as manganese and molybdenum, were found in widely scattered locations around the state. Manganese was first mined on Red Rock Island, located just south of the Richmond-San Rafael Bridge in San Francisco Bay, in 1866; mining continued on the island through 1875. Between 1888 and 1915, statewide production (ranging from zero to 1,500 tons per year) came mostly from mines in the Mad River Valley of Trinity County, east-central Mendocino County and neighboring areas of Lake County, the mountains southwest and south of Tracy in San Joaquin, Alameda, Santa Clara and Stanislaus counties, and in western San Luis Obispo County. These areas contributed 80% of the total. Some production came from desert areas, including mines in the Owls Hole District in north central San Bernardino County, the Ironwood and Little Maria Mountains in eastern Riverside County, and the Paymaster District in Imperial County. Miners obtained manganese through standard drift and stope methods, although some small deposits were tapped with open cuts. From 1915 through 1919, the

wartime market led to production of 70,000 tons, but between 1919 and 1941 very little was mined (CDM 1950:327–329). Molybdenum was first mined in 1915, and from 1915 through 1919 there was small production centered in Plumas, Inyo, Mono, San Diego, and Shasta counties. Molybdenum is often found in conjunction with tungsten, and mined in standard underground workings. Between 1919 and 1933 there was no production at all, and only a small amount in 1934. Mines in Inyo County began mining molybdenum again in 1939, as demand grew in defense industries (CDM 1950:337–340).

Commercial production of tungsten began in 1905, and between that year and 1950 some 40,000 short tons of 60-percent tungsten concentrates were processed. The Pine Creek Mine near Bishop in Inyo County was the principal producer of tungsten in both the state and nation, and held the largest known reserves. It also produced molybdenum, copper, silver and gold. Tungsten was geologically connected with the formation of the Sierra granitic batholith, and deposits of the metal occurred along the slopes of the Sierra Nevada from Kern and San Bernardino counties north to Madera and Mono counties. It was mined underground like the metals with which it was found. Production from all mines fluctuated in the years between 1905 and 1940, with production peaking during World War I. Between 1921 and 1922 there was no production at all, followed by peaks and lulls through 1940. The Division of Mines noted, "tungsten production reflects the eras of depression and prosperity, and has been further affected by tariff, war, and preparation for war" (CDM 1950:355–361).

The Cajalco/Temescal Tin Mine in Riverside County played a role in the United States' attempt at tin independence, an ambition not abandoned until the 1940s. The southern California mine, in fact, was the nation's leading producer in 1891 and 1892, although the output paled in comparison to global production. Ultimately California could not compete in this metal (Chaput 1985:1–24). The Division of Mines reported that while tin was discovered in the Temescal District of Riverside County as early as before the Civil War, it only produced tin ore in 1891–1892, along with some later production in 1928–1929. A total of about 113 long tons of ore were shipped from the district during these years. This did not constitute a significant amount, when one considers that domestic use of tin in the U.S. in 1940 was over 123,892 tons. The California Division of Mines reported that "the few scattered tin deposits of the continental United States and Alaska have contributed less than 0.02 percent of the world's production. California is among the few states with a recorded production of the metal" (USBM 1941:673–675; CDM 1950:349–352).

CHAPTER 3. PROPERTY TYPES

INTRODUCTION TO PROPERTY TYPE CATEGORIES

This chapter introduces types of archaeological resources associated with historic mining processes. These property types do not exist in isolation, but must be identified and interpreted within their functional context. As used here, property types recognize the individual building blocks of mining sites such as prospect areas, shafts, mills, and tailings ponds. Simple sites may have only one or two types while complex sites may have many, linked by function and time. These linked property types are what Donald Hardesty referred to as "feature systems" on mining sites in Nevada to distinguish "a group of archaeologically visible features and objects that is the product of a specific human activity" (1988:9). This is a useful way to tie together different features into a functional process. In general, site significance increases with the size, visibility and focus of these systems: focus indicating the clarity with which the story of archaeological remains can be "read," while visibility refers to the quantity of remains (Deetz 1996:94).

A similar, process-based approach to identifying property types is recommended in National Park Service's *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties* (Noble and Spude 1997).

Accurate interpretation of property types and feature systems—establishing function and time period—is critical. Determining that a pile of rocks is the result of placer or hard-rock mining, or that it dates to the Gold Rush or Depression era, directly affects its significance values. In addition, for many of these sites that will not be preserved (whose limited data potential is exhausted by its recordation), and will be affected by development projects, this identification may constitute its last examination and recording by archaeologists and historians. It is important that our final record of this mining activity be accurate. Interpretation is made more difficult when a mineral source is worked over several different time periods, with subsequent mining techniques and occupations erasing or overlying earlier remains. For sites with several property types or feature systems, interpretation is greatly facilitated by physically reconstructing deduced mining processes on a map, and perhaps in a flow chart, to ensure an accounting for all the potential resources and their relationships. For complex sites, a mining engineer can contribute much to this exercise.

The links between processes or activities and the common types of archaeological mining resources are drawn below, grouped under five categories:

1. prospecting and extraction;
2. ore processing;
3. intra-site ancillary facilities;
4. domestic remains pertaining to social, non-technological elements of mining; and
5. larger, regional linear sites that support the mining endeavor.

A description of the process that created the physical remains is provided, visual representations added to assist interpretation, and common tangible remains for each summarized. Mining sites can contain multiple property types from multiple categories.

PROSPECTING AND EXTRACTION PROPERTY TYPES

Mining involves locating and extracting various minerals from naturally occurring deposits. Prospecting is the act of searching for new mineral deposits and testing their value (Fay 1920:540). The two primary forms of deposits are lode and placer. Lode deposits are the original mineral occurrence within a fissure through country rock, also variously known as vein or ledge. Hard rock and quartz mining are two common terms referring to mineral extraction from lode deposits. Extracted lode minerals, especially those deep underground, generally require additional refinement, called beneficiation (discussed in Ore Processing Property Types below). Placer deposits are sedimentary formations containing minerals that have eroded from their parent lode into a variety of natural contexts, both shallow and deeply buried. The ubiquitous image of a 49er panning for gold along a gravel bar is well known, although hydraulic, drift, and dredge mining also targeted this type of deposit. Placer minerals are generally "free" from parent material and do not require additional refinement once separated from worthless sediment. Placer miners followed "color" up drainages looking for the source, and often thereby discovered the parent outcroppings of lode ore. They also discovered eroding ancient riverbeds, now elevated above the modern landscape, which contained naturally deposited placer gold as well. Later, geology played a larger role in locating minerals. Miners often used ingenuity and innovation to tailor their operations to local conditions for both lode and placer deposits. Prospecting and extraction technology differed for the two types of mineral deposits.

PLACER MINING PROPERTY TYPES

Placer Mining Property Types:

Tailings Piles
- Small piles of Placer Tailings
- Oblong piles of Placer Tailings
- Long lines of Placer Tailings
- Pits with Placer Tailings
- Surface Exposures of Placer Rock

Cut Banks, Channels and Placer Tailings

River Diversion

Dredge Tailings

Adits and Placer-Tailings Dumps

The primary means of separating gold from auriferous sediments relies on water and gravity. Water flow is used to move and agitate gravel, and gold's specific gravity ensures that it naturally settles under proper conditions. Dry placering, such as winnowing, may have been used in the absence of water; here wind blows the lighter component to the side while heavier material drops. There are several general references regarding historic placer technologies (Wilson 1907; Boericke 1936; Peele 1941; Rohe 1986; Silva 1986; Meals 1994; Tibbetts 1997; Lindström et al. 2000).

The simplest placer prospecting is typically done with a metal gold pan, a round shallow dish with flat bottom and slanted sides; wooden bateas and baskets were also used in the earliest years. Panning involves swirling a small amount of dirt and gravel with water in a manner that allows the lighter material to rise to the top for removal while the heavier fraction, particularly the gold, concentrates at the bottom. Panning can be carried out at the location of a placer deposit, or auriferous sediment can be collected using a variety of hand tools and taken to a convenient panning location. For example, gravel can be scraped out of crevices, with various kinds of metal bars, into a bucket and taken to a bar along a gently flowing creek where it can be easily panned. The method is limited to coarse gold, as fine particles tend to be lost with the gravel. The gold pan has endured, however, and metal and plastic versions can still be found in modern supply stores. Because of its simplicity, the pan is used for prospecting, as an extraction tool, and in combination with other technologies discussed below. Although widely used, evidence of panning in archaeological contexts is generally limited to the presence of the pan itself. Any evident changes to the ground surface would have been so minor that, combined with natural processes, they would have been erased. Hand tools such as picks, shovels, buckets, and wheelbarrows were the dominant method of transporting placer deposits to separating devices.

Tailings Piles

The most distinctive indicator of a placer mining site is the waste rock, or tailings piles left from the prospecting or mining. These rock piles – located in creek drainages, along bars and riverbanks, or at locations of ancient, exposed river deposits – consist of water-worn rocks and general lack of soil. Tailings piles come in different shapes and sizes, as noted below, depending on where they are on the landscape and how they were separated from gold-bearing gravels. Boulders and cobbles were often moved out of the way and piled or stacked to the side, while gravel and smaller cobbles were generally processed for gold. Water, necessary to wash the deposits, could, for small operations, consist of seasonal runoff or include short water diversions from nearby drainages. Large-scale mining might involve large ditch systems bringing water from afar. More extensive, long-term placer mining areas also often included habitations for the miners, and

Small Piles of Placer Tailings

A placer deposit worked by a rocker or cradle exhibits an undulating ground surface formed of piles of uniform-sized gravel and cobbles where the hopper was emptied. Piled or stacked cobbles and boulders may also have been moved out of the gravel bed. Metal, perforated screens (riddle plates or grizzlies) are diagnostic artifacts that are typically square, and range "16 to 20 inches on each side with one-half inch openings" (Silva 1986:3).

domestic remains may be found on some smaller operations as well.

The rocker, or cradle, is one of the simplest mining tools and can be operated by one individual. Named for its likeness to a baby cradle, it is essentially a wooden trough with a screened hopper on top and a handle that allows the operator to rock the device. Auriferous gravel is dumped into the hopper and enough water poured in to transport the finer sediments through the sieve, across an apron, and through a series of riffles. "Dry washers" were similar devices that did not require the use of water. Cobbles and gravel caught in the screen are cleaned out and dumped to the side. The apron, which was historically made of a cloth-like material such as canvas or burlap, collects coarse gold and directs fine material to the head of the riffle-lined trough, where fine gold settles. Riffles are a series of parallel slats of various designs fixed to the bottom of collection troughs that "retard the gravel and sand moving over them, and so give the gold a chance to settle" (Boericke 1936:62). Material collected from behind riffles was typically panned. The entire device is relatively portable, typically two to five feet long, one to two feet wide, and less than two feet in height. It was popular in California by 1849, and although designs continue to circulate in modern mining books, they are no longer widely used.

The long tom operates much like a rocker (Figure 1). Gravel is dumped into an open, inclined trough and drains through a screen into another box fitted with riffles. Coarse gold settles into perforated sheet iron that lines the initial trough, while the finer particles are captured in the riffle box below the sieve. The device relies on a steady current of gravity-fed water to move material instead of rocking, and no pressure, or head, is necessary. The flow is controlled, and must be stopped during frequent cleanouts. Material collected from behind riffles was typically panned. Widespread adoption of long toms in 1851 awaited development of a necessary water supply system (Rohe 1986:136). Perforated metal used in long toms may vary in dimensions, although designs generally include a flared riddle plate uncommon in other collection devices (Boericke 1936:60; Silva 1986:7; Lindström et al. 2000:68). As described by Wilson (1907:39), "the feed end of the tom is about 18 inches wide, while the discharge end is about 32 inches wide, and terminates in a perforated sheet-iron plate." Common water systems include a penstock, hose, flume, and ditch, or a combination of these.

Oblong Piles of Placer Tailings

The use of long-toms leaves a landscape similar to that of rockers, although the rock and gravel removed from the longer troughs create linear or oblong piles of uniform-sized gravel and cobbles, as much as 15 to 20 feet long. Other associated artifacts may include the flared, perforated sheet-iron plate.

A box or board sluice is a wooden, riffle-lined trough that operates much like a long tom, although typically 12-foot sections were interconnected to construct much longer devices (Peele 1941:10–561; Rohe 1986:137; see Figure 2). As with the long tom, the chain of sluice boxes was supplied with a controlled source of water, and was constructed to a suitable grade for collection, often requiring trestles. Water and gravel were introduced at the head, gold and heavy sediment collected behind riffles, and water and gravel—and fine minerals—exited the tail into a dump. Flow had to be stopped periodically to clean out concentrate from behind the riffles. Material collected from behind riffles was typically panned. Gravel could be shoveled in

manually, or brought to the feed sluice by wheelbarrow. Various means were employed to prevent clogging and damage by large rocks, such as a mud box fitted with a grizzly, or metal grate; "oversize material and boulders are forked out and thrown to one side after having been cleaned" (Boericke 1936:55). Undercurrents were used to increase collection of finer, gold-bearing sediments by diverting finer material through a grate along the bottom of the sluice to a large box designed to slow the flow of water enough to allow fine gold to settle. Sluice boxes were widely used by 1852 (Rohe 1986:137). Various metal grates or sieves used to help screen gravel and riffles were generally wood, although there are some metal designs such as angle iron (Peele 1941:10–566; Silva 1986:7). A water conveyance system would be present, although exclusive use of the sluice box would not result in steep cut banks, which would indicate ground sluicing or hydraulic technology. Sluicing resulted in impressive, distinctive landscapes (Figure 3).

Long Lines of Placer Tailings

The use of sluice boxes resulted in a landscape similar to that of a long tom, although straight linear piles of tailings usually exceeded 20 feet in length. Metal grates or angle iron riffles might be present. Steep cut banks are absent.

Hillsides composed of the eroding remains of ancient river channels could be prospected by surface prospecting and by ground sluicing. Small, shallow pits were excavated into the ground surface, and the soils removed for processing in a pan, cradle, or other sorting device. Water did not need to be brought to these prospecting locations. The pits were usually less than eight feet in diameter and only a few feet deep. A pattern of small, deep prospects is called "post-holing." Archaeologically they survive as shallow depressions with small adjacent piles of stream-washed cobbles. Where buried gold deposits were located, either in exposed modern river bottoms or elevated ancient ones, prospects were enlarged by "coyoting" (mining in irregular openings or burrows into the auriferous gravels; also see discussion below on Adits and Tailings). Dry placering employed this method as well. The work was considered quite dangerous as the ground matrix was unstable and cave-ins common. Archaeologically these prospects have collapsed and eroded and are distinguished from pit prospects only by the size of the adjacent tailings piles.

Pits with Placer Tailings

Small-scale prospecting of slope deposits resulted in an undulating landscape of depressions and mounds located on hillsides and ridges formed of ancient river channels. The depressions are less than ten feet in diameter and cobbles and other river rock are piled adjacent. Abundant pits with large adjacent rock piles may indicate an area of coyoting.

Cut Banks, Channels, and Placer Tailings

Combinations of cut banks, channels, and stacked or piled rocks are the result of ground sluice or hydraulic operations, or a combination of these methods. Both processes of excavating auriferous deposits relied on collection technologies described above. Disposal of the vast quantities of water and waste material needed for these operations was a major concern, and the variety of methods used for draining and managing waste is evident in the material remains. The feature systems resulting from sluicing and hydraulicking methods are similar.

A ground sluice is a channel or trough in the ground through which auriferous earth is washed. It may require carving into the bedrock to obtain the correct slope or grade for the bottom of the channel (Wilson 1907:40). Ground sluicing is also the act of caving-in and eroding the ground into a prepared channel using a steady stream of water and hand tools to remove overburden (Peele 1941:10–541). In all respects, what sets ground sluicing apart from box or board sluicing is the large quantities of water needed to excavate the ground. Booming is a variation in which the water was impounded nearby and released suddenly to cause a powerful gush of water against a bank or over a ground surface. A variety of material can be used for riffles in a ground sluice, including natural irregularities in the channel, cobbles, and wood poles. Cleaning out the concentrate from a ground sluice took place as needed. It involved removing all riffles and large stones, collecting all the sediment, and often extracting a few inches of bedrock; the result was an empty channel. The collected material would then typically be run through a board sluice, long tom, or rocker, and eventually the pan. It was also common to use board sluices at some phase of ground sluicing operations, including at the tail or in place of a ground sluice. Like the board sluice, ground sluicing became common in the early 1850s, and relied on dependable sources of water.

Cut Banks, Channels, and Placer Tailings

Ground sluicing and hydraulic mining produce similar landscapes characterized by substantial water conveyance features, and the presence of steep cut faces of varying heights at the edge of the worked area.

Hydraulic mining is a method in which a bank of auriferous material is washed away by a powerful jet of water and carried into sluices (Fay 1920:352). As the name suggests, an abundant water supply—and the means to build sufficient head, or pressure—is necessary. Water is typically conveyed from high on an adjacent hillside into a metal pipe (penstock) to build head, and then into canvas hoses fitted to a metal nozzle, or monitor, which directs the jet of water. In large operations giants were hooked directly to penstocks to contain the high pressure. Gold was collected in extensive sluice systems, often similar to the ground sluicing described above. Low-pressure models were developed in the 1850s, although substantial technological developments in high-pressure water wheels and delivery systems were accompanied by far greater gold production beginning in the early 1870s (Limbaugh 1999:34). Far greater dumping of processed waste sediment (i.e., mining debris) in waterways was another result. Judge Sawyer's 1884 decision in *Woodward vs. North Bloomfield* led to the 1893 Caminetti Act, federal legislation controlling hydraulic discharge into public waterways. Large-scale operations that could not control their discharge for whatever reason began closing down.

Lindström et al. (2000:62) noted the difficulty in differentiating hydraulic and ground sluice operations in archaeological interpretation, particularly for small-scale operations. In large-scale hydraulic mines, pressurized water systems, steep cliffs, and abundant tailings in noticeable hydraulic pits and dumping grounds should be apparent. Typically small operations elevated a monitor on a stable platform to keep it dry and above flowing gravel and water (see Figure 4). Archaeologically this looks like a flattened rock pile in front of a concaved bank (see Figure 5); there is no equivalent need for such a feature in ground sluicing, whereby the water is

delivered via a race, or ditch, above the cut face. Peele (1941:10–551) describes ideal monitor placement for larger operations.

River Diversion

Mining the beds of existing rivers required special techniques. One historically popular method involved turning a river from its bed in order to process the underlying gravels, popularly accomplished by wing dams, flumes, and channel diversion. A wing dam was constructed down a stretch of river, parallel to the bed, connecting upper and lower cross dams in a manner that would box a segment of riverbed (Figure 6). The flow that continued down behind the wing dam sometimes operated a pump—often called a Chinese pump—that would continue draining the contained portion of the riverbed. Fluming involved construction of a head and tail dam, and a flume erected between them, thereby exposing an entire width of a river segment. In channel diversion, a parallel channel was made for the river alongside the natural one, and the river diverted into it. A stream course could be moved back and forth across a drainage over a period of mining. River mining was widely practiced in California beginning in the early 1850s (Rohe 1986:140), and reached its peak in the mid-1850s (Meals 1994:10), although miners used these methods as late as the 1880s.

> **River Channel Diversion**
> While a river will typically reclaim its course and obliterate evidence of this activity, some elements of the diversion means may survive along banks, such as dams and ditches. For smaller courses, evidence of parallel channels and stacked-rock retaining walls may indicate a temporary channel diversion. Sedimentation may have partially buried some elements.

Dredge Tailings

Dredge mining allowed the profitable recovery of gold-bearing material that paid as little as five cents per cubic yard. Successfully used in California by 1898, and continuing into the 1960s, the bucket-line dredge consists of a "mechanical excavator and a screening and washing plant, both mounted on a floating hull" (Peele 1941:10–577). The dredge, anchored by a spud or post that could be raised or lowered at the stern of the hull, was floated in an artificial pond where it excavated a channel in deep gravel plains. Gravel was processed through a series of gold-saving devices, and the large volume of waste cobbles deposited by conveyor into a series of uniform tailings piles. The dredge would pull forward, following the excavated channel and leaving the tailings to fill in behind. Large-scale models were adapted to California's gravel plains, particularly where the Feather, Yuba, and American rivers, flowing from the Sierra Nevada, entered the Sacramento Valley.

The dragline or doodlebug dredge was developed in the 1930s and operated for about a decade in California. The dredging unit consists of two parts: a shore-based power shovel equipped with a dragline bucket, and a floating washing plant, similar to but smaller than the one on a bucket-line dredge. The dragline works from the edge of the bank above the pond where the washing plant is floating. The bucket was cast into the pond, hitting the bottom teeth-first. Then it was rotated and filled by pulling it toward the power shovel with the dragline. When the bucket was hoisted up it was swung over the hopper on the washing plant and

dumped; then the cycle started again. The bucket cut away the bank on which the dragline sat, so it had to move backwards as the pond and washing plant advanced toward it. Dragline dredges were "generally well suited to relatively small, shallow deposits which are too small to amortize a bucket-line dredge or too wet or low grade to be profitably worked by hand or other small-scale methods" (Wells 1966:12).

When the washing plant is mounted on wheels or skids, the dredge is called a dry land dredge (Wells 1966:13). These machines were only used in special situations such as places where the ground had to be put back to its original state by returning the tailings into the pit, leveling it over and planting it. The existence of very shallow deposits would also make it more appropriate because it could only dig about half as deep as the draglines. These dredges operated in California in the 1930s and 1940s.

Dredge Tailings

Large, multiple piles of river cobbles with little or no soil covering, extending over a large area.

Bucket-line

Vast tailings fields with high, rounded, parallel rows of cobbles.

Dragline

Clusters of conical, or rounded, individual piles; a pond was once present.

Dry-land dredge

Clusters of conical, or rounded, individual piles; no pond present.

The signal outcome of bucket-line dredging is vast tailings fields that encompass hundreds of acres. Tailings left by bucket-line dredges are distinctive in that they consist of high rounded rows of cobbles created by the arc of the stacker as the dredge pivoted on its spud (Figure 7). The rows angle away from the forward direction of the plant and each one represents a single pass. Ponds, dredge parts, and wire rope are also items that may be noted in an abandoned dredge field.

Dragline dredge tailings are deposited in large individual piles, rather than in continuous arcs. They are usually conical, unless they have weathered down to more rounded shapes. They are often in clusters, or in rows if the dredge was following a stream course. Because of their size, shape, and configuration, dragline dredge tailings are easily distinguished from bucket-line dredge tailings, but not from dry-land dredge tailings. Also found in clustered and conical piles, dry land dredge tailings can be confused with those from a dragline (Figure 8). The most reliable way to differentiate between the two would be by determining whether or not a pond was present, which would indicate the presence of a dragline. Mining company records would be helpful as well.

Adits and Placer-Tailings Dumps

Accessing buried placer deposits using underground mining techniques of adits and shafts is called drift mining. Prospecting for bench or Tertiary placer deposits elevated above drainages or locked beneath ancient volcanic flows often results in a pock-marking of small pits spread over a hillside. When fertile ground was found, larger excavations included coyoting or drift mining into the old river channels (see discussion above on pits). The "paystreak" is reached through an adit or shallow shaft and wheelbarrows or small rail-cars may be used for transporting the gravel to a sluice on the surface. If large, the paystreak can be taken in a series of regular cuts or slices. Drift mining is more expensive than sluicing or hydraulicking and is

consequently used only in rich ground (Thrush 1968:351). Substantial drift mines were operating across California by the mid-1850s (Rohe 1986:146–147). The method reached its peak in the 1870s, before virtually ceasing, only to be revived after 1933 (Peele 1941:10-606). Excavated sedimentary material deposited near a drift mine is distinguished from a lode mine's angular waste rock by its water-washed cobbles and gravels. Openings into the ground may be barely noticeable slumps, or extend into the slope a measurable distance. Rail or hoist remains may be present. The facilities for processing gravel, most likely a sluice, could be on-site, or some reasonable distance away depending on the transportation methods and water source.

Adits and Placer Tailings

Drift mines will be located in geological deposits containing old riverbeds. Waste rock will look like placer tailings, composed of cobbles. The adits and shafts may have caved in. Water is not required on site so ditches may not be present. Ore car routes may be evident.

HARD ROCK (LODE) MINING PROPERTY TYPES

<u>**Hard Rock (Lode) Mining Property Types:**</u>

- **Small Pits and Surface Vein Workings**
- **Waste Rock Piles**
- **Shafts and Adits and Facilities in their Vicinity**
- **Underground Workings**
- **Open Pit Mines**

Lode refers to a mineral deposit located in fissures in country rock, and is nearly synonymous with the term vein as used by geologists. Lode deposits are tabular and clearly bounded, with orientations measured by their "dip" (angle from the horizontal) and "strike" (angle from the vertical). Although lodes may extend to the surface, they primarily lie underground and are accessed by excavations such as shafts and adits, or by open pit mines. Ore (mineral-bearing rock) extracted from the lode is usually processed first through crushing and then by physical or chemical separation devices. Lode sites produce waste rock (excavated rock that is not ore) and tailings (the discharge of unwanted processed material from mills and separators). Good discussions of lode technologies are found in Peele (1941), Hardesty (1988), Bailey (1996), Pearson (1996) Bunyak (1998), Limbaugh and Fuller (2004), and Twitty (2005).

Lode deposits, varying greatly, define the nature of the extraction and milling technologies applied to them. They are often grouped into geologic occurrences identified as zones, the most famous of which in California is the Mother Lode, extending through five counties. Lode deposits can vary greatly in depth and width, with some surface quartz leads pinching out within a few hundred feet of the surface while a few extended to a depth of more than six thousand feet with widths sometimes exceeding fifty feet. Most lode miners on the Mother Lode did not encounter major ore bodies until their workings reached five hundred or more feet in depth (Limbaugh and Fuller 2004:42–43).

Lode mining tends to be more complex than placer mining, requiring advanced technologies, skilled personnel, and substantial capital investment. Also, unlike placer gold, extracted ore requires processing to free its minerals. Surface ore was naturally oxidized and its values could often be retrieved through simple crushing and physical separation. As veins extended deeper into the earth, however, gold was typically chemically bound with sulfides and other mineral compounds. Miners developed various chemical processes to separate them (discussed below in Section 2: Ore Processing). Although extraction and processing technologies evolved over time, older techniques continued where newer ones were too expensive or inappropriate for the scale of the effort. What was the state-of-the-art in the industry was not necessarily what was practiced on the ground. As pointed out by the co-authors of *Calaveras Gold: The Impact of Mining on a Mother Lode County*, Mother Lode historian Ronald H. Limbaugh and geologist Willard P. Fuller:

> It must be remembered that many goldmines on the Mother Lode and most of those on the adjacent belts were small operations too poorly financed to afford trained staff and the most recent improvements in mining machinery. In general, California mines probably modernized slower than those in other western districts, partly because of the size and cost factors, and partly because of a traditional conservatism among Mother Lode mine owners and operators that persisted down nearly to the present day [2004:183–184].

Many hard-rock miners worked only seasonally, on weekends, or between jobs. The ingenuity and inventiveness of these frugal miners also produced unique solutions to mining problems. Rancher James D. McCarty set up a two-stamp mill on his Defiance claim in 1910, putting a tractor-boiler up on blocks to supply steam power (Figure 9).

The range of hard rock technologies is vast and complex and will not be detailed in this section; instead, a description of the types of features commonly present on sites is described and some examples provided. Examples of mines from the Copperopolis district in Calaveras County, recorded for the Historic American Engineering Record (HAER), are available online (HAER 2007).

Small Pits and Surface Vein Workings

Surface vein workings are among the oldest evidence of hard-rock mining in California. During even the earliest years of the gold rush, placer miners were following "color" (gold) up gulches and encountering outcrops of quartz veins. Although "bull" veins (those without ore) were the most common, traces of gold were evident in some outcroppings and prospectors learned to search these out. Float, mineralized rock broken out from eroding veins, indicated a nearby source, and "gossans"—surface mineralizations of iron-heavy deposits—signified mineral veins underneath. Prospecting tools included picks, bars, and shovels and, in larger operations, wheelbarrows and ore cars to move ore and waste rock. Typically, an exposed vein

> **Small Pits and Surface Vein Workings**
>
> This includes pits with adjacent quarried rocks (not stream cobbles), or exposures of uplifted strata of country rock with excavated-out veins. Adits and other evidence of hard-rock mining and exploration will likely be in the vicinity. On larger workings, an arrastra or small mill might have been located nearby.

was simply followed down into its outcropping, leaving an exposed rock strata with its center gouged out like a cavity in a large tooth. The sides of these excavations are usually uneven as digging simply ceased at the limits of the ore. The floors of these workings have generally filled in over the years with silt and natural debris, but larger examples often exhibit an "exit" on a downhill side for removal of rock, or a platform for a windlass or hoist in deep excavations. Waste rock will be conveniently disposed of near the workings. Included in the waste rock may be chunks of bull quartz, a good sign that the excavators were following a vein.

Some kind of crusher was required to pulverize the recovered ore to release the gold or other minerals. This might have been a small stamp mill (two to five stamps) or an arrastra (see discussion below). The facility might have been near the vein workings, or next to a source of water with the ore transported to its location. If the mining is productive, and the vein deepens, there might be an adit driven in on the lode further down the hillside. At Carson Hill, on the Stanislaus River, the original 1850s surface vein workings that led to nearly a century of rich mining operations are still extant on the crest of a ridge.

Waste Rock Piles

Perhaps the most visible evidence of underground workings is waste rock. In following a vein, the vast majority of excavated rock is that surrounding the ore, and this waste rock is discarded immediately at the opening to the mine, allowed to accumulate in a downhill, gravity-formed mound or dump. Piles of waste rock not only indicate the location of uphill shafts and adits (which may be caved in and therefore not easily identifiable), but the size of the pile reflects the extent of the underground workings. Waste has also been used for roadbeds and other improvements, however, so the size of the pile should be viewed with caution. Waste dumps are visible as unnatural contours on hillsides and for the lack of soil development and vegetation. For larger operations, waste-rock piles may be formed by dumping rock from ore cars, producing a long, flat-topped ridge that begins at the mine portal and is extended as the workings deepen. Mines that operated for a long time often incorporated waste rock dumps into later development, terracing them for placement of buildings or other facilities (Figure 10). As mineral-recovery techniques improved over time, old waste rock with low mineral values was (and still is) processed to extract its values.

Waste Rock Piles
Country rock dumped into gravity-formed piles with little or no topsoil and vegetation. Their presence indicates the locations of mine portals and underground workings.

Shafts and Adits and Facilities in their Vicinity

The entrance to underground workings is called a portal, and opens into either a shaft or an adit, providing access to the lode. Shafts sink down into the ground from the surface and can be vertical or on an incline, while adits are driven horizontally into hillsides (adits are often referred to as "tunnels," however, among miners this latter term is reserved for horizontal passages that have an entrance and an exit, as along roads and railroad grades). Shafts and adits vary according to the size of mining operation and the nature of the surrounding rock. Portals will often be first identified by their associated waste-rock piles (see discussion above) as their openings may have caved in or been closed by dynamiting. Shaft-like openings that do not have

any associated waste rock are likely air vents connected to deeper workings, or daylight stopes (where ore excavations break the surface). When cut into a stable matrix, shafts are typically square while adits may have a curved ceiling. Where the surrounding rock is unstable, square shoring is used to reinforce the sides.

> **Shafts and Adits and Facilities in their Vicinity**
> Shafts are square (or caved in) holes in the surface and may have surrounding footings for head frames and hoists. An adit's entrance into a hillside may be evident, or appear as a caved-in trench. Shafts and adits are accompanied by waste rock piles on their downhill sides. Shafts without waste rock may be air vents or daylight stopes.

Shafts and adits require mechanisms for removal of underground waste rock and ore, and remains of these facilities are commonly present around the openings. Adits most frequently have ore cars running on tramways, or just a dirt path for wheelbarrows on smaller operations. Shafts require a hoisting device to raise the excavated material. While small shafts may operate with hand-run windlasses, larger operations require head frames with cables, buckets, and drum hoists (Figure 11). Footings for head frames straddle the shaft opening and remains typically consist of concrete bases topped with metal plates or bolts. Adjacent to these would be similar footings for the hoist drum. As mines deepened, devices such as Cornish pumps were installed to both ventilate and de-water the underground workings. Hoist power was provided by animals, steam, water, fossil fuel, and, later, electricity. Evidence for the power source might be found in massive boiler footings, a compressor, or engine mounts run by imported electricity or a generator.

The openings to deep shafts were usually collared with timbers and planks (Figure 12), or concrete (after the 1880s) to stabilize the work area, although collapse of these openings after abandonment often makes them appear as large craters. In ranchlands, abandoned shafts are often surrounded with fencing to keep out livestock. **The bottoms of these large depressions are very unstable – often consisting of only a thin soil developed over fallen timbers and tree limbs – *and should never be entered*.**

Underground Workings

Shafts and adits are built to access underground workings, a series of excavations providing access to the lode. Drifts (horizontal connectors) link various parts of the mine while mining the ore body itself is frequently referred to as stoping. Underground miners sort the material they are sending to the surface into waste rock and ore so those at the top can handle each ore car lode efficiently. ***Examination of underground workings is very dangerous and is prohibited by Caltrans*.** The size, nature, and surrounding geology of mines are vital to understanding its history. This information must be found in documentary records.

> **Underground Workings**
> These are indicated by shafts, adits, and waste rock dumps. They are **NOT** to be explored but must be studied through documents.

Open Pit Mines

> **Open Pit Mines**
> Large pits excavated in stepped layers with haul roads. They may have facilities nearby. Glory holes remove ore and rock underground from the center of the pit.

Low-grade ores located near the surface could be mined through an open pit system, much like a large quarry where rock is removed systematically in stepped benches. Excavation is generally by controlled blasting, the ore separated and hauled to the mill and the waste disposed of nearby. In modern times both ore and rock are typically loaded with large shovels and carried out by truck. Support facilities include a road system, machine shop or garage, and office. Some open pit mines used a leaching system to extract gold, and such ponds may be located nearby. Pit excavations are also sometimes called "glory holes," although this term more accurately indicates surface excavations where the rock and ore is gravity-fed out from the bottom, as in a funnel, and removed through an adit. In this case, waste rock, milling, and transport systems will accumulate near the adit portal and not the excavation area.

ORE PROCESSING (BENEFICIATION) PROPERTY TYPES

Once ore has been removed from a mine, valuable minerals must be separated from the gangue (undesired minerals). Beneficiation is a broadly applied term and can include crushing, stamping, screening, flotation, amalgamation, and smelting (Cowie et al. 2005:13–24). The technology of beneficiation developed diverse and sophisticated processes over the past centuries and only those most commonly found on sites in California are mentioned below. Milling sites often contain innovative and complex technologies that were added to and modified over time. Interpretation of these types of sites is dependent on thorough use of mining reports and documents and frequently requires the help of mining engineers.

<u>**Ore Processing Property Types:**</u>

Arrastras
Mills: Industrial Foundations, Pads, and Machine Mounts
Mill Tailings

ARRASTRAS

An arrastra (or arrastre) is a shallow circular pit, rock-lined on its sides and flat bottom, in which broken ore is pulverized by drag stones. These are attached to horizontal poles fastened to a central pillar and typically rotated by use of animal or human power, although later machine-powered examples can be found. The base or floor stones are usually of a hard material such as marble and exhibit a polished surface (Figure 13). The upper drag stones also have a polished, smooth undersurface and evidence of a bolt attachment imbedded on top. Although not commonly encountered in the field, these simple grinding devices are significant

indicators of early mining activities and were also used into the 20th century on low-budget projects (Figure 14).

> **Arrastra**
> A shallow, flat-bottomed circular depression typically less than 20 feet in diameter, lined on its edges and floor with stones. The base and drag stones are of a hard quality and exhibit polished surfaces.

Introduced by Mexican miners (*arrastrar* = to drag), they could be constructed with materials at hand and were quite effective in reducing ore to a powder, from which gold could be recovered by amalgamation or other simple separation processes. This type of milling is most productive for surface vein workings, where the ore has been naturally oxidized and does not require chemical processes for mineral recovery. Arrastras are rarely found intact as, upon abandonment, the floor stones are typically pulled up and the underlying soils panned to retrieve gold that sifted between the cracks. Discussion of arrastras are found in Kelly and Kelly (1983) and in Van Bueren (2004).

MILLS: INDUSTRIAL FOUNDATIONS, PADS, AND MACHINE MOUNTS

Mills are not necessarily constructed adjacent to mine portals, although they may be. Mills require a power source and a steady supply of water, and it may be more expedient to locate the mill in the best place to access those requirements and transport the ore. Mills may also be centrally located to serve a series of mines.

The first step in ore processing is crushing the rock into a powder that can be treated. The most common technology for accomplishing this was stamp mills, where ore was fed into a cast-iron mortar box located under a battery of heavy vertical rods (see also discussion of arrastras above). Through use of overhead cams, the rods were repeatedly raised about six inches and then allowed to fall, their heat-treated shoes falling on the mortar dies. The camshaft was rotated eighty to one hundred times a minute by a belt-driven bull wheel, powered initially by water or steam (Limbaugh and Fuller 2004:65). Small, mobile, one- or two-stamp mills were effective on small sites, although batteries of five stamps were soon found to be the most effective. Stamp mills often grew in increments of two five-stamp batteries as operations expanded, resulting in some large mills of 100 and 120 stamps.

Archaeological evidence of mill sites increases with their size and permanency. Small, early mills were relatively ephemeral and temporary, leaving few traces. Unless the stamp mill itself was abandoned—leaving cast-iron shoes, cams, rods, and hopper-mortars in place—their short-term operations may not be identified. Larger stamp mills can involve large excavations of earth and leave distinctive terraces, often with equipment mounts or foundations (Figure 15). They were nearly always built into hillsides, taking advantage of gravity feed to move ore through the stages of processing. At the uppermost level, ore was delivered to the facility by tram or other vehicle, stored in bins and then fed into the hopper of a primary crusher where it was reduced to a uniform size. Jaw crushers were initially preferred, later largely replaced by ball mills (Figure 16), where ore was rotated with iron balls in large barrel-like devices (worn iron balls often mark these locations). Crushed ore was then fed through a grizzly (screen) into the stamps, where it was pulverized with the controlled use of water, creating pulp. The

number of stamps is documented by footings for the batteries, grouped into five or ten per footing. The width of the stamping floor often defines the width of the mill building itself.

Mills

The remains of these sites generally appear as large terraces on hillsides, the size reflecting the number of stamps present. The stamp terrace has a large back wall to stabilize the stamps, and footings for the batteries may be evident. The lower terrace is for concentrating the pulp, and mill tailings will be found below. Various pads and machinery mounts around the mill reflect necessary support devices. A water source and method of transporting ore to and from the mill may be evident.

Below the stamps, the lower level of the mill contains the amalgamation or concentrating tables. Here the discharged pulp, with the addition of small amounts of mercury ("quicksilver"), was processed to recover the gold. This level has drains to carry off excess water from this wet processing area. Below the amalgamation level, pulp may be further processed in chlorination or cyanide tanks, or other innovative device, for final recovery. After 1870, various devices were introduced to improve this process and maximize the recovery of free gold in the concentrates, the vanner being among the most important (Limbaugh and Fuller 2004). The amalgam was then retorted to drive off (and then recapture) mercury with the resulting gold "sponge" shipped to a mint or smelter, or sometimes ingots were prepared on site. The final discards are dumped downhill as tailings.

Simple amalgamation worked well with free-milling gold, but not with refractory ores where gold was tightly bonded with other metallic minerals. In these, while gold was often clearly visible in ore samples, milling and the use of mercury did not permit its recovery. It took years of experimentation before solutions were found, and many tailings piles from early mills were later reworked to recover their gold or silver with improved processing. In the 1870s, chlorination was the first breakthrough, but even this was expensive and relatively ineffective and was only productively used on large ventures. Cyanide was used with some success in the early 1900s, applied to reground slimes from ore initially treated with chlorination. Later flotation methods subjected the treated pulp to a frothing agent which separated the minerals in cell-like devices. Heap leaching of chunk ore was also sometimes successful in recovering values from low-grade ores. No single recovery method worked in all mills, however, because of the different composition of local ores. For most mines, the final step was smelting through the application of heat. Prior to 1863, copper was shipped to the east coast or Swansea, Wales, for smelting; after that time it was sent to a facility at Antioch and later to the only West Coast smelter in Tacoma, Washington. California's only major smelter (for gold, silver, copper, lead and zinc) was started in San Francisco but soon moved to Selby, immediately east of Martinez along the margin of Suisun Bay. The Selby smelter was the only one operating in 1940 (USBM 1941:230; Limbaugh and Fuller 2004:66–67, 80, 176–191).

In the early years, mills were run by steam, produced in boilers or furnaces, and by water-powered impulse wheels, modeled on those made by Pelton. Remains of boilers may be evident adjacent to mill sites and are distinguished by rectangular platforms of brick or other refractory insulating material which encompassed large, iron horizontal-boilers. Furnaces also powered steam plants and compressors and their remains may be accompanied by a below-grade slot, or

"well," to accommodate the fly wheel. Pelton-type wheels were often installed along the side of a mill where they would turn a bull wheel. They required heavy foundations and mounts, and a "well" to accommodate the wheel's rotation. A steady stream of pressurized water, delivered by an adjacent ditch or canal, blasted "buckets" at the end of the spokes, and remains of these devices will include channels for runoff.

In the 1890s electrical power plants began to be built, sometimes by independent entities and sometimes by the mining interests themselves. Engine mounts in mills are characterized by raised concrete footings topped by heavy bolts. Evidence of electrical power may also be evident in wire conduits, switch boxes, and insulators. In later years, on remote sites, local generators may also have been used.

Mill Tailings

The undesired portion of the ore discharged from mills is identified as tailings. They were generally in the form of slurry, and for most of the 19th century were allowed to run down adjacent creeks and gullies. A federal anti-debris law, the Caminetti Act of 1893, prohibited miners from dumping their waste into rivers and streams. While aimed primarily at hydraulic mining debris, this act also addressed lode mine tailings. As a result, mills began constructing impound areas. These tailings ponds were typically formed by constructing a dam across a downstream ravine and allowing the tailings to build up behind it. Heavier portions of the tailings settled into flat, meadow-like formations while the water portion ran over a spillway. Abandoned with their mills, the dams for these holding ponds were typically breached in later years, allowing the stream to cut through the accumulated tailings and reach its bed once again. These breached ponds can be identified by the cliff-like sides of the stream exposing mineral-colored fines unlike the surrounding soils, and remnants of the flat pond surface preserved along the sides of the drainage.

Tailings could also be carried as slurry to neighboring ravines and pond locations some distance from the mill. This is the case in Jackson, where the unique Kennedy Tailing Wheels lifted mill tailings to a retention pond over an adjacent ridge. Mill tailings contain high levels of minerals and are often distinguished not only by their coloration but by an absence of vegetation. At the New Melones Reservoir a valley filled with stark white tailings from the Carson Hill Gold Mines mill is visible from Highway 49 at low water (Figure 17). Many modern reclamation efforts are designed to contain old tailings and prevent water from leaching their often toxic contents into waterways.

ANCILLARY MINING PROPERTY TYPES

These are other site-specific facilities and systems that are commonly found in association with extraction and beneficiation activities. They represent important internal components assisting mining and milling operations.

<u>**Ancillary Mining Property Types**</u>

Structural Remains (ruins)
- Office
- Change Room
- Blacksmith/Mechanic Shop
- Shed/store/warehouse
- Garage
- Stable/corral

Site-Specific Transportation Features (ruins)
- Ore car routes, trestles, tramways
- Trails, paths, walkways
- Roads, haul roads
- Railways

Site-Specific Water Conveyance Systems
- Dam/reservoir
- Ditch/flume/conduit/siphon/penstock
- Tanks/cisterns
- Drains

STRUCTURAL REMAINS

Mining sites may contain a myriad of buildings related to their mining and milling operations. Although some may be identifiable by distinctive artifacts, construction techniques, or locations, identification of most are achieved through comparing documentary records (mine inventories, photographs, and maps) with remains on the ground. Long-operating mines periodically upgraded or revamped their operations, and over time buildings may have been moved, demolished, or changed in function. Every building or structure in evidence on a site may not have been functioning at the same time.

Other Structural Remains

Foundations or pads located around mining or milling sites represent various functions, some of which may be evident from the related artifacts. Those with domestic artifacts are discussed under mining community below.

Building remains may be from offices, sheds, storage buildings, stables and shops, locations of which may be indicated by concrete or stone foundations or simply leveled pads and retaining walls. Wooden structures were often covered with metal sheeting and may be

evidenced by lumber, cut or wire nails, building hardware, or fragments of window glass. Assay offices may be distinguished by the remains of furnaces or retorting facilities, as well as fragments of crucibles and cupels.

Change rooms, where company gear and workers' personal equipment could be stored, are located next to mine portals or mills and later may have featured concrete floors and piped water for showering. These facilities were installed not only for the convenience of the workers, but to prevent high-grading (theft) of ore by employees.

Powder houses stored the mine's explosives and were usually located some distance from other structures. These were usually small windowless rooms, often semi-subterranean (commonly built into a hillside) and featured thick walls of stone, brick, or concrete.

Blacksmith shops maintained a mine's equipment and vehicles, and their former locations may contain various pieces of worked metal, raw materials, coal or coke, and slag from forging; the remains of the forge may also be evident. One of a mine blacksmith's principal duties was sharpening miners' drills. Nineteenth-century mines had stables and corrals for livestock used to haul ore cars and wagons. Stone foundations and wood posts with wire fence lines may be evident. At the Empire Mine, mules were stabled underground. More recent mines required a garage and shop which may feature tanks for oil and gasoline, grease pits, and vehicle parts.

Structural remains with domestic artifacts (ceramics, bottles, and cans) are discussed below under "Mining Community."

SITE-SPECIFIC TRANSPORTATION FEATURES

Within a mining site, transportation systems were needed to move ore, waste rock, and people. On the simplest sites, hauling was done by the miners themselves or by pack animals on single-track trails. Even modest development, however, had to address how to remove waste rock from lode mines and deposit it out of the way. Ore cars were often utilized within underground workings to move excavated material toward the surface. For adit portals, tramways for ore cars commonly ran out the entrance along a level grade to the adjacent waste rock dump, both being extended as the mine deepened. Tramways were also used to haul ore to mills for processing, either run along prepared grades or on trestles. The ore cars could be powered by animals, gravity, fossil fuels, or electricity. In the 1890s before the Royal Mill was constructed, tram mules hauled ore cars down hill from the Royal shaft to the Pine Log Mill, returning with empty cars on their own for a ration of oats (HAER 2007: Document No. CA-81). Tramways can be recognized by their uniform grades and the presence of rails and ties. Overhead tramways with buckets suspended on cables, were also used to connect mines in inaccessible locations to mills or transportation facilities (Figure 18).

> **Trails, Roads, and Tramways**
> These linear features are visible as continuous grades leading to critical areas of the mine or mill. Tramways feature rails and ties. Aerial tramway sites where artifacts have survived are typified by cables, head frames, and buckets.

Roads were always present to connect mine facilities, and these grew in importance when trucks replaced tramways for hauling both ore and waste rock.

SITE-SPECIFIC WATER CONVEYANCE SYSTEMS

Water played an important role both in placer mining and in processing lode ore. For placer mining, refer to role in placer extraction section above.

Water was required for all types of milling; conveyance and storage systems will be present on sites. Reservoirs, cisterns, and water tanks may be found above mills to allow for gravity feed while distribution may have been done in pipes. Remains of old riveted penstock systems may be present. Drains and methods to direct run-off from the mills will also be in evidence.

> **Water Conveyance Systems**
> Reservoirs, cisterns and tanks are located uphill of mills to allow for gravity feed. Ditches, pipes and penstocks were used to move water around the facility. Drains removed spent water from the mill area.

Water conveyance systems bringing water to a mill from sources some distance away (outside of the site boundaries) are recorded separately as individual sites. They may have tapped resources many miles away and served several mines or communities in the vicinity. These are discussed below under Inter-Site Mining Support types. Water conveyance systems for mines are also described in detail, with recordation methods and registration requirements, in the JRP/Caltrans *Water Conveyance Systems in California* (JRP and Caltrans 2000).

MINING COMMUNITY PROPERTY TYPES

Miners often lived at the mines, and this property type addresses facilities related to the domestic residential activities of the miners, the mine's support staff, and their families. Although often marked by impermanence, mining-camp residents created a distinct community (Douglass 1998:106) that is integral to the study of the mining site. The domestic property types discussed below must be physically and historically associated with prospecting, extraction, or milling activities. Resources related to mining-site residences, if present, are generally found integrated within or adjacent to mineral operations. Metal detection can help identify associated sheet refuse useful for interpreting foundations. There may be numerous remains of structures on mining sites, especially more developed ones, that generally fit the architectural remains described below (see Property Type Structural Remains under Ancillary Mining Property Types). However, the residential property types addressed here must be distinguished by one or more of the following:

1. presence of domestic artifacts,
2. distinctive domestic features such as hearths or baking ovens, or
3. identification as residence-related in documents.

In many respects the mining community reflects a work camp composed for mining. Communities brought together primarily for the mineral industry may also grow into townsites, with diminished connections to their mining roots. Modern towns along the Mother Lode's Highway 49 amply demonstrate this evolution. Mining community resources can resemble types discussed in the Work Camps and Town Sites Research Designs, and additional discussions of these types of resources may be found in those companion documents. Isolated residential sites may also be found along water conveyance, transportation, or utility lines, as well as in areas of agricultural development. Such sites should be addressed by research designs appropriate to those topics, although they may share many attributes of Mining, Work Camp, and Townsite properties.

<u>Mining Community Property Types:</u>

Domestic Structural Remains (residential and/or service)

- Earthen pads
- Foundations
- Cuts/dugouts
- Chimney/oven

Domestic Artifact Deposits

- Sheet refuse
- Hollow-filled features

Domestic Landscape Features

DOMESTIC STRUCTURAL REMAINS

> **Earthen Pads**
> Located close to placer-mining remains, these leveled pads may have a downhill retaining wall and a stone hearth. They are characterized by a sparse scatter of domestic artifacts as sheet refuse.

The simplest temporary dwelling form is the tent, or lean-to with a canvas cover. An improvement was a half-walled version where the lower sides of a one-room dwelling was made of logs or lumber and the sides of the canvas roof could be rolled down to close the walls. Located on natural earthen flats or leveled pads, these simple dwellings required little in the way of site improvements and could be easily moved to the next opportunity. A tent flat can be barely noticeable if located on a naturally level area but on slopes may be distinguished by a small retaining wall (as minimal as one row of stones) on the downhill side. Improved earthen pads may be surrounded on one or more sides by a shallow ditch created by building up the pad; these also provided drainage. Sparse sheet refuse is usually found on the flat itself or extending downhill away from the shelter. Metal detection can help identify associated sheet refuse. The presence of a few large stones may indicate a U-shaped hearth or fire ring. These hearths may consist of flat stones set on end to form firebreak, or a few courses of stacked local rock. Stone oven remains have also been found associated with placer mining tent pads (see discussion below). These types of dwellings are generally found in close proximity to small-scale placer mining remains

(more extensive placering and hard-rock mining required greater investment in developing the mine and housing was similarly more permanent).

More substantial dwellings employed stone foundations to raise wooden walls and floors above ground level; these can include stone piers to support posts or floor joists as well as complete stone perimeter foundations. Flat stones used as post footings on a flat can be barely noticeable, such as those used for simple cabins like the ubiquitous, two-room miners' cottage (Bell 1998:31). Post-and-pier construction was used into the early-20th century for frame dwellings as well as for bunk-houses and dining halls found on some mining sites. Domestic structures with stone masonry walls, or of adobe or rammed-earth, may also be present (Figure 19). A full or partial cellar, typically reinforced with stone masonry, may have been incorporated. Roofs were commonly of metal or wood. Supervisors or managers may have resided on-site in large or unique structures, possibly higher in elevation or across from common laborers housing.

Later, poured concrete slabs and perimeter foundations were used for housing. Concrete constructions are common on well-developed mining sites after 1890. Board-formed poured foundations date to after the First World War, although smaller sites may have continued using simple stone technologies. Sites dating to the 20th century show increasing evidence over time of utilities for electric lighting, telephone, and domestic water supply.

Foundations

All the types below are associated with domestic artifacts or have been identified as domestic facilities through historical research. Any may be located on natural level areas or on prepared structure platforms with retaining walls and may have evidence of fireplaces. Structures over 30 feet long may be bunk-houses or dining halls.

Stone Piers or Perimeter Foundations

Arranged symmetrically to support a frame building.

Stone, Adobe, or Rammed-Earth Walls

Collapsed or partially standing stone building; adobe or rammed-earth may have "melted," leaving an earthen berm.

Concrete Piers or Perimeter Foundations

Generally post-dating 1900, they have bolts, sill boards, or other devices to affix the overlying frame building.

On more developed mines, evidence of large foundations (exceeding 30 feet in length) in association with personal domestic debris may represent bunkhouses or other collective housing. Community dining halls and kitchens will be distinguished by large refuse piles containing tablewares; large cans, bottle, and jars; and faunal remains.

A dugout describes an open, often rock-lined cavity in a hillside, usually the size of a single room (Figure 20). In the mining community these generally served the same functions as discussed above for foundations: they were used as dwellings as well as for other functions such as storage. Most simply they could appear as a single slumped-in cut into the hillside. Better developed examples were fully excavated and may have been lined with stone, poured concrete, or milled lumber framing,

Cuts/Dugouts

Commonly appear as collapsed cuts into the hillside, or basement-like areas, possibly stone-lined, associated with domestic household artifacts.

and supported metal or wood roofing. Wood construction elements, if not entirely decayed, will likely be collapsed within. Dugouts are typically at least partially filled-in, often burying structural elements and living surfaces. For large dugouts, the removed fill should be visible around the structure.

Some mining residence areas may contain cooking features, and any of the features described below may be found on domestic mining sites. Simple hearths are discussed above under "earthen pads." More developed residences may contain evidence of stone fireplace with a chimney. The hearth itself was typically made of stone, and the chimney of stone, mud-and-stick, or pipe. Similarly, a separate area for preparing food or a more formal cookhouse may have contained a dome-shaped bake oven. Where collapsed, these appear as roundish piles of stones, about 10–15 feet in diameter, with the centers collapsed into a cavity and stones typically resting at steep angles (Figure 21). In the Mother Lode, these are most commonly associated with Italians, although they were also constructed and used by French, German, and Hispanic residents (Costello 1981; Wegars 1991). In later years, they incorporated modern materials such as brick, concrete, and cast-iron doors. A distinctive curved free-standing wall – an *asado* – was used by Chileans and Peruvians to cook flayed cattle. Overseas Chinese also constructed U-shaped stone hearths in the vicinity of their diggings (Tordoff and Seldner 1987; Tordoff and Maniery 1989; Medin 2002) identified by the presence of ceramics and other artifacts from their homeland. Often these suspected piles of stone must be carefully excavated to reveal their original forms and functions.

Cooking Features
Stone features on a residential site may be associated with fireplaces, ovens, or other cooking facilities.

DOMESTIC ARTIFACT DEPOSITS

Domestic artifact deposits are also discussed in the Work Camps and Town Sites Research Designs. The examples below identify those commonly found on mining sites.

Domestic sheet refuse describes a horizontal scattering of discarded items typically found around a dwelling, and is one of the most common types of domestic artifact deposits on rural mining sites. Artifact accumulation results from unintended loss as well as intentional waste disposal such as casting debris away from a dwelling. Sheet refuse may be found throughout the living area of a dwelling, or as deposit located adjacent to and downhill from the residence area. Disposal of debris into natural features such as gullies may create vertical interfaces similar to the "hollow filled features" discussed below. Metal detection is helpful in identifying boundaries of discrete surface deposits.

Domestic Sheet Refuse
Domestic artifacts found in the vicinity of a dwelling, conveniently deposited on the surface by the occupants.

In both situations, sheet refuse may retain a form of horizontal stratigraphy that represents unique activities or episodes; one occupant may have discarded debris one direction, while another may have tossed debris in another, thereby creating distinguishable deposits. Don Hardesty (1987:85) noted this quality on mining sites, recognizing that site components may be

organized horizontally instead of vertically. The implications of this for research and integrity have been recognized as an important element of evaluations (Cowie et al. 2005:62).

Developed mines with sedentary communities that resemble a town more than a camp may exhibit more intentional methods of refuse disposal, such as designating a communal dump. Artifact deposits are found buried or partially eroding from features such as trash pits or prospect pits, or from privies, wells, dugouts, cellars, or ditches abandoned at the time of disposal. It should be noted that artifacts found in abandoned features, such as basement depressions, likely reflect activities after the facility was abandoned, not the period of use. These hollow-filled features offer a rich assemblage of artifacts potentially with traditional vertical stratigraphy. Many of these types of features are buried, however, and must be explored through excavation or use of documents. The location and excavation of these types of features is discussed in the Town Sites Research Design.

Hollow-Filled Feature
Concentrated deposits of artifacts disposed of in features such as trash pits, prospects, privies, cellars, or other abandoned features.

DOMESTIC LANDSCAPE FEATURES

Members of the mining community may have made a number of minor improvements to the landscape. Residents may have planted a garden or orchard, or created areas to pass the time or socialize. These activities survive in the form of stone garden terraces or retaining walls, surviving plantings, bedding borders, or walkways. In some more developed operations the ruins of more sophisticated recreation facilities, such as parks or ball fields, may be present – features discussed under the Towns Research Design.

Plantings
Exotic plantings that can survive untended such as bulbs, trees, and rose bushes.

Stonework
Lined paths, retaining walls, and terraces.

INTER-SITE, MINING SUPPORT PROPERTY TYPES

These are separate, distinct sites that may extend many miles, creating a link between the mining site and the outside world. They represent linear systems for delivery of services or access and are recorded as individual and distinct entities. The nexus of these common property types with a particular mine, however, are contributing elements of that mining site.

Inter-site, Mining Support Property Types:

Inter-site Transportation Features
- Trails
- Roads

Inter-site Water Conveyance Systems
- Ditch
- Flume

Inter-site Utilities

INTER-SITE LINEAR TRANSPORTATION FEATURES

> **Trails and Roads**
> Trails were narrow and often marked with downhill rock retaining walls on hillsides. Wagon roads were wider and less steep, and later roads for motorized vehicles were often paved.

Early access to mines was by way of single-track trail, such as the network of mule trails that quickly developed to service mining camps during the Gold Rush. Such trails are narrow and often have stone masonry retaining walls; their width is most accurately measured at switchbacks and outcrops. Segments of trails are often completely erased by later activities. Wagon roads replaced portions of these systems as some areas grew into viable settlements. These typically have stone masonry, and often a berm on the downhill side from grading and often replace the steeper grades of trails with longer routes. Over time, additional road improvements, such as oiling, macadam, or paving, became standard practice. Earthen and paved roads form a network across the rural landscape. Mining operations patched into existing transportation networks or financed their own service connections. Large, capitalized operations, in particular, typically improved road systems linking to the larger transportation network. Byrd (1992) provides a general history of road development to 1940, while Bethel (1999) offers an overview specifically for 19th-century gold mining.

INTER-SITE WATER CONVEYANCE SYSTEMS

Water is necessary for many aspects of mining, and when an intra-site supply was not developed (see discussion above for intra-site, ancillary mining property types), operations depended on an inter-site water conveyance system for its delivery. The mining company may have developed its own water supply—buying up and improving on earlier claims and

systems—or purchased water from the owner of a ditch system. These linear systems can be quite large, extending for miles beyond a mine. Typical components include catchment or take-out, storage, and delivery features. Elements are discussed at length in the JRP/Caltrans (2000) report on water conveyance systems, and by Shelly Davis-King (1990), both of which provide the general features of mining ditches. Intra-site water conveyance systems typically took water from an inter-site system, often first directing water into the mine's own storage feature, via a ditch, flume, or penstock. The history of a mining site's water system is vital to understanding its development and the source of water should be identified for each operation.

> **Ditches**
> Paths of streams of water excavated across the landscape on contours; downhill berms are typical and may be reinforced with rock.
>
> **Reservoirs**
> Dams were typically made of stone and earth.
>
> **Flumes**
> Often no longer extant, may be indicated by missing segments of ditches over creeks or steep hillsides.
>
> **Pipes**
> Riveted iron pipe carried water down hillsides, or siphoned over creeks.

The primary feature that will be archaeologically visible in the vicinity of a mine is an earth-berm ditch, possibly with associated stone masonry or penstock. Ditch segments may be filled with sediment, or in places entirely eroded away. As the grades of ditches remained steady, their routes can be determined across a landscape even when large segments are no longer extant. Natural gullies were often used to move water quickly to a lower elevation, where it would be picked up again by a lower section of ditch. Remains of parallel ditches are often found in close proximity and may represent water from the same source being taken to different destinations, or an improvement in the grade of a ditch at a later period of time. Small side-hill ditches – long, narrow reservoir-like hillside features – caught seasonal surface runoff and supplied mining operations below. Flumes of any antiquity are usually in disrepair if extant at all; more likely they exist as an alignment of fasteners. Remains of gates, pipes, or penstock may survive as ferrous metal and poured concrete reinforcement. During World War II many abandoned segments of riveted pipe were collected for scrap and shipped to coastal shipyards.

INTER-SITE UTILITIES

Some mining operations required services, such as power and communication, to be delivered via utility lines. The development of electrical generating plants in the 1890s was pioneered by mining companies to supply their needs as they had both capital and incentive (Limbaugh and Fuller 2004:182). Later, power companies were established to provide electricity, linking mines to complex networks of power generation and storage reaching far and wide. Telephone communication also became important and large enterprises had lines laid into their operations. Utility poles might be present, although lines were often hung from existing trees fitted with insulators. The mines near Copperopolis were, in 1901, linked by a telephone service run partially along the barbed wire of fences (Fuller et al. 1996:69).

> **Poles**
> Cut or standing poles and glass and ceramic insulators.

Chapter 4. Current Research Themes

INTRODUCTION TO MINING RESEARCH

This chapter explores research themes for mining resources important to both historians and archaeologists. They are:

1. Technology: general works related to the Gold Rush, and to mining and technological development;
2. Historical Ethnography: culture history and individual stories of mining sites and their populations;
3. Ethnicity: studies of distinctive cultural groups and ethnic interactions;
4. Women and Family: the role of women and children;
5. Economy: market development, consumption, and class; and
6. Policy: law, regulation, and self-governance.

Themes are integrated through references and examples with the historic context and property types presented in earlier chapters. Research themes change over time as scholarly and public interest advances. Following each theme are examples of specific questions; the lists are suggestive rather than exhaustive. Under every research topic are questions designed to establish base-line knowledge useful toward advancing the themes discussed. Considered in isolation from their scholarly context, many of these research questions may seem unsophisticated for they are not intrinsically important and are not posed to elicit simple unequivocal answers. Their role is to stimulate the researcher's imagination in productive directions in relation to the research themes from which they were developed. Higher order questions that rely on these site-specific particulars are also illustrated. Answers to the questions may be found in both or either the documentary and archaeological records, and oral history may also be available. A solid understanding of all data sets extends the conclusions that can be made in a complimentary manner. The final chapter will explain how these themes link to evaluation of mining sites and implementation of mitigation measures.

HISTORICAL STUDIES OF MINING

The history of the Gold Rush and of mining in California is one of the most documented and studied aspects of California history. Almost from the moment the Gold Rush began, authors began documenting the experience of "seeing the elephant." In later years, trade publications, industry journals, government publications and reports, and a myriad of other sources have examined the development of the mining industry in the state. It is not the purpose of this chapter to create a comprehensive bibliography or synthesis, or summarize all of these works; rather, the goal is to present a discussion of some of the major works, and

characterize the research themes, interests, and questions historians have posed or addressed in the recent past. For example, a review of periodical literature for the years 1990 through 2006 for the subject of mining in California revealed hundreds of journal articles, theses, dissertations, and scholarly works. It should be noted, however, that the overwhelming majority of these focused on aspects of Gold Rush history.

Monographs and periodical literature during the last decades have focused on the several principal topics noted as Themes in this chapter. The following discussion is not meant to be exhaustive or all-inclusive—rather, it is meant to point out the main areas of study. Many recent works will be discussed, but space does not permit a full discussion of all such items.

Famous standard works such as Rodman Paul's (1947) *California Gold: The Beginning of Mining in the Far West* or (1963) *Mining Frontiers of the Far West, 1848–1880*, provide a broad contextual narrative regarding the California gold rush and its expansion, while J.S. Holliday's (1981) *The World Rushed In*, provides a wealth of primary accounts of the early Gold Rush era. The California Historical Society's *A Golden State: Mining and Economic Development in Gold Rush California*, edited by James J. Rawls and Richard Orsi (1999), contains a compendium of articles from the society's *Quarterly* (now *California History*) that focus on a wide variety of subjects related to the Gold Rush and mining industry that is a valuable starting place for anyone studying mining in California. Many of the articles collected in this work are discussed below. Duane Smith's (1993) *Mining America: the Industry and the Environment, 1800–1980* provides a national view of the mining industry that places California in that context. Mark Wyman's (1979) *Hard Rock Epic: Western Miners and the Industrial Revolution, 1860–1910* and Richard Lingenfelter's (1974) *The Hard Rock Miners: A History of the Mining Labor Movement in the American West, 1863–1893* address issues related to labor and capital in the mines, mine safety, and other subjects. Although they focus on the mining areas of the West rather than just California, they provide important background for understanding the role of labor in the mining industry. More recent works, such as Susan Johnson's (2000) *Roaring Camp: the Social World of the California Gold Rush*, applies social history's methods to the Southern Mines of the Mother Lode. An example of a work addressing mining towns and their development is Ralph Mann's (1982) *After the Gold Rush: Society in Grass Valley and Nevada City, California, 1849–1870*, which examines the evolution of those two mining camps into mining towns. Finally, Charles Wallace Miller Jr.'s (1998) *The Automobile Gold Rushes and Depression Era Mining* looks primarily at small scale mining during the years of the 1930s, prior to the advent of defense buildup in industry before World War II.

Over the last three decades, mining and related subjects have been frequent topics of articles in periodical historical literature. A review of recent articles on mining and related topics addressed hundreds of articles and classified them according to themes (see Table 5). The following discussion focuses on some of these articles and the questions raised by them.

Table 5. Published History Articles on Mining by Topic

Topic	Number of Articles
Technology	
▪ General mining	13
▪ Mining methods and techniques	9
▪ Mining metals other than gold	9
Historical Ethnography	
▪ Specific locations (mining camps, sites, towns)	29
▪ Individuals	5
Ethnicity	
▪ Race	55
▪ Race and gender issues	9
Women and Family	12
Policy: Law and Government	9
Economy	
▪ Business	9
Transportation	13
Environment	14
Agriculture	6
After the Gold Rush	6
Miscellaneous	11
Total	209

STUDIES OF ARCHAEOLOGICAL SITES

Archaeologists are anthropologists, and therefore are not simply interested in sites and objects as interesting relics, but in what stories these remains can tell us about the people who made them. The interests of archaeologists have evolved with the discipline and today include a wide range of approaches from scientific descriptions to imaginative musings. This diversity is useful as each site presents its unique record of the past. It is also important to note that most archaeological studies of mining sites are a result of cultural resource management evaluations, where sites are not selected for size or prominence or uniqueness, but because of their relation to some undertaking. This very democratic process of resource selection has allowed archaeologists to examine a broad sample of mining remains in the state. Below are highlights of the archaeology of mining over the last half century, and many other examples are provided under the prevailing research themes that follow.

Some of the earliest and largest investigations of gold mining resources in the State were conducted in preparation for large dam projects during the 1960s and 1970s. Initial "salvage archaeological reconnaissance" along the American River, for example, identified 45 historic-era sites, 18 of which contained foundations and 14 had clearly mining-related elements (Childress and Ritter 1967). Most had shafts or adits, and two arrastras were noted. Subsequent work on 34

of the sites investigated for the Auburn Dam project, however, categorically dismissed gold mining resources, concluding, "when artifacts are absent and there is no associated cultural deposit, there seems little basis for additional archaeological work" (True 1976:6).

Development of New Melones Lake led to extensive cultural resource studies between 1968 and the early 1980s along the Mother Lode's Stanislaus River drainage. Of the 442 recorded historic resources, more than 60 percent were mining sites (Moratto et al. 1988:v). Multiple phases of work were carried out by teams of historians and archaeologists, only a portion of which is documented in reports (Fitting et al. 1979, Moratto et al. 1988). One approach examined the results within Frontier (self-sufficiency), Victorian, and Dependency theoretical frameworks (Greenwood 1982; Greenwood and Shoup 1983). Here, contrasting social structures of placer and lode gold miners was observed: placer miners exhibited a mixture of Frontier and Dependency models characterized by labor-intensive cooperatives, sharing, and using simple technologies; whereas lode miners reflected strictly dependant attributes evidenced by imported and expensive industrial technologies, a large wage-labor force, and financing and management by "metropolitan based corporations" (Greenwood and Shoup 1983:273).

The Cottonwood Creek Archaeological Project in Shasta and Tehama Counties provide additional comparable data on gold mining resources (Johnson and Theodoratus 1984a; 1984b). The Cottonwood Creek area was heavily placer mined from 1848 until 1870, initially by Euroamericans and later by Chinese. Within the 45,000-acre project area, 405 cultural resources were documented, 89 of which related to gold mining. Of these, over 70 percent of the placer mining sites were considered potentially eligible to NRHP: 54 contributed to the proposed Gas Point Historic Mining District; 9 were "evaluated as a group;" and another particularly large site spanning over 50 acres (CA-SHA-1330H) was considered a "complete mining system" (Johnson and Theodoratus 1984a:333). The 13 historic sites selected for additional archaeological testing represented temporary habitations adjacent to placer mining (Tordoff and Seldner 1987). Research questions addressed issues related to chronology, water use, mining organization, ethnicity, and social interaction. Of special concern were the Chinese occupation and this group's relationship with Euroamericans. The study of historic Chinese has achieved special recognition in archaeology owing in large part to the presence of distinctive imported artifacts at their sites (see Theme 3). Addressing research questions was hampered, however, by the lack of either exclusively Euroamerican or Chinese mining habitations as well as poor historical associations (Tordoff and Seldner 1987:221). The researchers concluded that, "Given the nature of these sites as demonstrated by this and other recent projects, careful recording can result in obtaining, at the survey level, much of the data necessary to identify the system and its parts, settlement patterns, and some information on ethnicity" (Tordoff and Seldner 1987:248).

Rising gold values in the 1980s led to a resurgence of mining which, combined with new environmental regulations, fueled archaeological studies of mining sites (Spude 1990a:3). In 1982 the South Dakota State Historical Preservation Center (SDSHPC) determined that mining sites "had received insufficient research, interpretation and preservation attention" specifically in response to the Homestake Mining Company's proposal to reopen a large mine (Torma 1987:1). In 1987 SDSHPC and the State Historical Society sponsored a workshop to pull together

their findings on historic mining resources in order to define research questions for evaluation and preservation (Buechler 1987). The multi-disciplinary team summarized a variety of advances made in mining research and included perspectives from social and industrial history, mine engineering, geology, cultural geography, and historical archaeology. The idea that mining remains should be considered part of a feature system instead of isolated elements (Spude 1987:55; Hardesty 1987), the concept of mining landscapes (Alanen 1987:61), horizontal stratigraphy in mining contexts (Hardesty 1987), and the notion that mining history benefits from archaeological resource-based analysis (Miller 1987:31), all gained traction at this workshop.

Cultural geographer Arnold Alanen's workshop findings are particularly useful for interpreting the physical remains and social behavior correlates of a mining landscape. He offers a typology of mining communities and several social comparisons, recognizing that archaeological investigations can reveal much about daily life that is otherwise unobtainable (Alanen 1987:63–67). Landscape historian Richard Francaviglia (1991), in his book *Hard Places*, also documents the distinctive imprint of mining on the land. He interprets these sites as representing more than technological processes, but also reflecting the opposing forces of culture and the environment, and the traits of "competitiveness, risk taking, male identity and power, and dominance over nature."

Donald L. Hardesty, of University of Nevada, Reno, is arguably today's most influential mining-sites archaeologist. Two decades ago he suggested that sites be measured against a "significance evaluation matrix" of seven topics—environment, technology, diet and consumption, social organization, demography, ideology, and chronology. Each topic could be addressed on any of three scales: world systems, mining district, or feature systems (Hardesty 1987:88). Hardesty (1988) compiled two decades of compliance-based mining archaeology in Nevada for the Society for Historical Archaeology's publication *The Archaeology of Mining and Miners: A View from the Silver State*. Using the state's extensive lode gold and silver mining history between 1860 and 1930, Hardesty's monograph employs case studies to illustrate various property types, historic context, and potential research avenues. Hardesty distinguishes between historical archaeology and industrial archaeology, noting that limiting studies to "detailed architectural and engineering descriptions of surviving machinery and buildings" does "not seem broad enough to take advantage of the information contained in the archaeological record of mining sites" (1988:17).

The National Park Service added to this growing dialogue by sponsoring a weeklong historic mining conference in 1989 to improve the management of mining resources. The resulting proceedings covered topics on historic context, inventory and evaluation measures, compliance and management considerations, views on interpretation, the use of HAER forms, and several case studies (Barker and Huston 1990). Several participants (including Feierabend, Huston, and Spude) reinforced the view that abandoned mining regions should be evaluated as distinct landscape districts, while case studies by Rogers and Waters demonstrated the advantages of interpretation at this scale. Ronald Reno (1990:56) reminded fellow conference attendees that "the mining district has been recognized by most researchers as an ideal study unit for mining activities."

Hardesty (1990:41) applies the term "historical ethnography," citing Schuyler (1988), to the reconstruction of past lifeways using site-specific particulars as an interpretive approach to mining resources. An excellent example of this is found in George Teague's early study of the Reward Mine and two related camps inhabited in part by Papago miners from the 1880s to the 1920s (Teague 1980). The detailed integration of historic context and artifact analysis provides an intimate picture of the mining sites as well as illuminating their place in the emerging nation. His observations on the evolution of camp buildings document "an aimless alignment in the earlier years, and a rigid, symmetrical, and parallel arrangement after the turn of the century," leading him to postulate an essential human tendency to move toward order and homogeneity, demonstrated in this region's transition from a frontier setting to an industrial community (Teague 1980:152–153).

The technology of mining is featured prominently in Robert Gordon and Patrick Malone's (1994) *The Texture of Industry*. In this overview of industrial archaeology the authors stress the development of technological processes and how workers used space and adapted to changing work environments, citing numerous examples. Archaeological studies of the social fabric of mining sites are presented in *Social Approaches to an Industrial Past: the Archaeology and Anthropology of Mining* (Knapp et al. 1998). Mining communities are addressed, as well as the role of women in these male-dominated settlements. These studies, and many others, are combined with works by historians in the following thematic discussions.

THEME 1: TECHNOLOGY

This vital topic addresses the mining process itself including technological development, regional diversifications, and spread of technologies. National Register Bulletin 42 (Noble and Spude 1997:14) advocates interpreting the layout of industrial feature systems to elucidate the nature and sequence of industrial development, emphasizing the identification of variability and change in the study of mining technology and mining landscapes. It suggests looking at "conditions under which innovations in mining technology take place and are accepted or rejected," as well as the "characteristics and evolution of mining landscapes" (Noble and Spude 1997:17). Just as interesting as innovation is the persistence of older and simple techniques in the face of more modern alternatives. Historians and historical archaeologists have contributed to bodies of literature on mining technology. Understanding the history of complex sites with various phases of work benefits by synthesizing archival and archaeological resources.

Historian Phillip Ross May's (1970) *The Origins of Hydraulic Mining in California* explores the origins of that mining technique. The technology of mining and beneficiation, particularly in lode mining, are the subject of a number of works, including Eric Twitty's (2005) *Riches to Rust*, Lynn Bailey's (1996) *Supplying the Mining World: The Mining Equipment Manufacturers of San Francisco, 1850–1900* and (2002) *Shaft Furnaces and Beehive Kilns: A History of Smelting in the Far West, 1863–1900*, and Dawn Bunyak's (1998) interesting *Frothers, Bubbles and Flotation: A Survey of Flotation Milling in the Twentieth Century Metals Industry*.

Applied technologies are dependent on the whims and attitudes of the miners. H.M. Smith's (1903) *Overland Monthly* article, "Placer Mining," discusses the fact that while much was written about the abundance of gold in El Dorado County, fewer articles address changes in mining objectives. Smith gives an account of one instance, where miners in El Dorado County concentrated first on placer mining, picking up all the gold they could wash out of the gold-bearing soils. Only when this gold began to peter out, Smith reports, did they expend energy on the considerable gold they knew was in local quartz deposits.

On any site where evidence of mining activities is visible, the first and perhaps most important task is to identify what techniques were used. The remains provide clues to these processes, and from this foundation the story of the site can be developed. Archaeological sites containing features of poorly documented practices offer particularly valuable data. Individual and small-scale miners, for example, produced few technical records of their feats, aside from occasional entries in a journal. One of the few large-scale interpretations specifically of placer mining landscapes is Neville Ritchie's (1981) development of a typology for placer tailings in the Clutha Valley of New Zealand. Over 500 mining sites were recorded and divided into 11 types representing the most successful mining methods developed by 1880, along with possible regional preferences. By mapping out the process, Ritchie found that the organization of the placer tailings, ditches, and cuts varies depending on mining techniques and the type of placer deposit. Although habitation areas, and issues of chronology and ethnicity, are not investigated in this study, Ritchie suggests that future studies could incorporate these elements into the typology, rendering an even more useful tool for extracting important information from these sites.

A landscape approach that involves seriating related features is useful to help situate mining features in chronological order. While most of this information will come from mining documents and identification of mining systems, excavation of some rare mining features—such as arrastras—may also enhance this relative dating exercise. Inter-site comparisons can reflect technological development of entire mining districts in the same manner. A good example of this is the reconstruction of the evolving landscape in the long-lived Felix-Hodson mining district near Copperopolis. Six maps of the district between 1848 and 1986, illustrating the narrative history, depict the changing locations and numbers of mines and habitations, and illustrate the interdependency of mining, water, and communities (Fuller et al. 1996). The result of a 5-year study by historians and archaeologists, the maps' detail and accuracy relies on data from both disciplines.

Rohe (1986:154) notes, "The often described progression of mining methods (pan, rocker, tom, sluice, hydraulic, dredge) from simple to advanced is both an overgeneralization and misleading for most areas of the West." Tordoff and Maniery (1986:1–12) compared archaeological evidence with the popular history that depicts Chinese miners' use of shovel, pick, pan, and cradle. Two small Chinese mining camps in Butte County dating to the 1870s–1880s included stone hearth features and artifact concentrations on terraces above mined-out areas and placer tailings. Mining features included "nearby small tailings piles and water conveyance ditches" and artifacts recovered include penstock fragments, shovels, and picks (Tordoff and Maniery 1986:63). While the authors conclude that the Chinese relied on panning

and rocking, supporting the common image, the oblong tailing piles and attendant water system also indicate that the more ambitious long tom or sluice was utilized.

Older technologies often persist well beyond their initial popularity, often because they are simple and inexpensive to build and can be operated by a single miner (Van Bueren 2004:8). “As a technological method and concept, arrastras outlasted other means except panning and sluice boxes, but without much change in form” (Kelly and Kelly 1983:93). Arrastras persisted on small lode sites into the 1950s, often identifying the location of a “part-time” miner. In 1880, Guiseppe Torre acquired a substantial ranch near Sutter Creek on which he built four arrastras by 1884. Leasing the mineral rights to fellow Italian Antonio Canone, he reclaimed the poorly-producing mining operation in 1892 through a loan default. It is unlikely that the arrastras operated again (Van Bueren 2004:17–21). Members of Calaveras County’s pioneering Fischer family developed cattle ranches around Mokelumne Hill (Hoeper 1995:19). A small arrastra of cemented stone sitting next to Highway 26 remains from their efforts to earn some extra money during the Great Depression.

Mining-site researchers are increasingly curious about Depression-era mining. The low-tech methods used during the Gold Rush were also practiced in a subsequent century by depression-era miners and by ranchers looking sporadically for ore, as noted above. The second all-time high of gold production—totaling $50.9 million (Clark 1979:6)—occurred during this period, and it is a topic of increasing interest as the 1930s pass farther into the past (Smith 2006). Oral history can be a strong component of any research into this era. The archaeology of two small habitations associated with Depression-era gold mining in Siskiyou County depict a lifestyle characterized as “self-sufficient poverty,” whereby gold provided a means for acquiring essentials. Both sites consist of cabin remains and artifact deposits surrounded by mining features; one site surrounded by large “prospect holes” resulting from pocket mining (a typical small-scale form of lode mining), and the other by evidence of ground sluicing (Winthrop, Gray, and Winthrop 1987:34). Evidence from these sites—which are generally poorly represented in the archival records—demonstrates the renaissance of simple technologies requiring little investment.

Researchers have discovered innovative and vernacular technologies; notable adaptations unique to a site or region. Often these indicate a lack of capital funding, causing the mining operation to turn to inventive solutions. At the Defiance mine and mill near Copperopolis, built by local rancher Jackson D. McCarty in 1910, power for the two-stamp mill was supplied by a converted tractor boiler, set up on blocks with its wheels pulled off (Figure 8). The mill ran until as late as 1938 (Fuller and Costello 1990a:6). Many early- to mid-20th-century desert-mining sites have truck chassis on mounts to provide power to equipment.

Van Bueren’s (1998:32–35) study of the small mine in Amador County mentioned above, demonstrates the benefits of framing research around both industrial and social elements of a mining site. The Canone Mine was a ca. 1880–1892 small-scale, owner-operated lode mine employing multiple arrastras for processing. Besides the remains of arrastras, the site included water conveyance systems, modest surface workings, and “meager evidence of occupation” (1998:54). Archaeological data helped understand exactly how the arrastra operated and, with the documentary research, linked the technology, scale, duration, and success of the operation

with the ethnicity (Italian), class (low-income and single), and residence of the operator (living at the mine). By looking at the overall use of arrastras in California and the West, Van Bueren concludes that arrastra technology was marginalized by the industry because of cultural preference. Its association with Mexican miners during the Gold Rush established its image as a "poor man's" tool, shunned by "modern" miners who embraced newer technologies even though they could be more costly and less efficient (Van Bueren 2004).

Questions

- What type of mineral (or minerals) was mined?
- What mining processes are evident on the site? How did they operate/function?
- How were processes adapted to specific conditions? Is there evidence of reuse or replacement?
- During what time period (or periods) was the mine worked?
- How did mining processes change through time on the site?
- Do mining processes evident on the site agree with or differ from those documented in records?
- Why were certain mining methods selected (e.g., expense, cost constraints, limited availability, cultural preference, innovations)?
- Was the mine operated periodically (e.g., seasonally)? Why?
- How was water for industrial and domestic uses delivered? Did miners develop their own water sources on site or satisfy their water needs (both domestic and industrial) by tapping into a larger system?
- Who owned, managed, or operated the mine (e.g., individual, joint stock, corporate investment, etc.)?
- Who made up the labor force? How did it change with time?
- Is there documentary or archaeological evidence that specific ethnic/cultural groups are associated with identified mining remains?
- Did changes in technology or management practices influence the layout of the mine, operations, or the workforce (e.g., sale of property, rise of labor unions, reduction of laborers, change in hiring practices)?
- Are the technologies older than those common during the time period that the site was active?
- Is there evidence of vernacular innovation? Under what conditions did this innovation occur?

THEME 2: HISTORICAL ETHNOGRAPHY

This type of research focuses on compiling a detailed story—or culture history—of a given mining settlement or individual, and is conducted by both historians and historical archaeologists. Robert Schuyler (1988:39) first applied the term historic ethnography to the practice of compiling culture history at the community level using archaeological and textual data equally. Ethnographic and oral history are also key ingredients if applicable. Hardesty (1990:41) suggested using the concept for developing questions specifically about mining and miners; "Questions that are important to historical ethnography have to do with the geographical and historical context of community, household, ideology and world view, ethnicity and ethnic relations, social geography and structure, political organization, economics, and technology and the workplace, among other things." Historians have produced considerable literature regarding specific mining camps and miners. Studies of archaeologically definable households are commonly carried out for cultural resources management projects as they provide intimate glimpses of the site's occupants. The following examples are grouped under settlement, individuals, and households and community.

SETTLEMENT

There is a wealth of focused works on specific mining camps or districts. Many center on remote locations or romantic stories, such as L. Burr Belden's (1985) *Mines of Death Valley*. Others, like Robert Palazzo's (1996) *Darwin, California*, or Leland Fetzer's (2002) *A Good Camp: Gold Mines of Julian and the Cuyamacas*, describing the development of small mining towns and the composition of their population. Such specialized books can be found for many mining camps or towns throughout the state, and the collection of such works is often a valuable first step in any study of mines in a specific area. Other works, like Remi Nadeau's (1992) *Ghost Towns & Mining Camps of California: A History and Guide*, are collections of short histories of mining camps around the State. Kate Willmarth Green (2001a, 2001b) wrote her works, *Like A Leaf Upon The Current Cast: An Intimate History of Shady Flat, Neighboring Gold Rush Landmarks & Pioneer Families Along the North Fork of the Yuba River Between Downieville & Sierra City, California*, and *Like A Leaf Upon The Current Cast: Supplement to 2nd Edition: Chapter 9; Additions & Corrections*, to fill a gap in the history of Sierra County. To this end, the books examine the history of the little settlement of Shady Flat and its relationship to the other such settlements along the Yuba River. Green sees Shady Flat as a "cross-section of the invading people who came to settle these parts and the events that were played out in the gold camps of California." She discusses its formation, the various ethnic groups that lived there, and early politics of the area, and also looks at settlements down- and upriver of Shady Flat. Of course, one of the most famous contributions to our understanding of women's lives in the early years of mining in California are the collected letters of "Dame Shirley" (Louise Amelia Knapp Smith Clappe), first published in 1854 and republished in 1933 with an introduction and notes by Carl I. Wheat as *California in 1851; The Letters of Dame Shirley*.

County histories are also valuable sources, although often dated or limited to the 19th or early 20th centuries. W.A. Chalfant's *The Story of Inyo* (1933), for example, has a number of chapters on mines, mining camps, prospecting, small smelters, and other mining-related subjects. *Calaveras Gold: : The Impact of Mining on a Mother Lode County* is a comprehensive study of mining in this county, written by University of the Pacific historian Ronald H. Limbaugh and mining engineer Willard P. Fuller (2004). It recounts the story of individual mines but also puts this local history in the context of national and international economic events and technological innovations.

Malcolm Rohrbough (2000), in his *California History* article "No Boy's Play: Migration and Settlement in Early Gold Rush California," addresses the accounts of men and women who poured into California in search of gold. Rohrbough seeks to clarify patterns of migration and settlement, noting that most miners did not form permanent settlements as they intended to get rich and go home. Only later in the Gold Rush did permanent settlements begin to emerge. The late J.S. Holliday's (1998) *California History* article "Reverberations of the California Gold Rush" notes that the historic record was filled with accounts of men flocking to the Gold Rush in California, but not with the words of men yearning to return home. Holliday reports the transitory nature of most of the early settlers in California, and his article is filled with accounts of wives calling their husbands home, and husbands' explanations why they could not yet leave. He celebrates the free and transitory nature of early California settlement and the inventive and industrious nature of early inhabitants. Holliday compares reminiscences of California's Gold Rush to those of the Civil War in the south. Both have been romanticized, both invoked pride, and both created a sense of a shared experience.

Archaeology tends to focus on specific sites or districts, presenting opportunity to examine settlement at a variety of scales. In her Logtown Historic Mining District study, Tordoff (2005) combines social, economic, and industrial approaches. The remains there are associated with placer mining and settlement dating to 1850, and the transformation into a small community dependant on the local lode-mining industry that lasted until about 1900. This mixed approach generated many links between the development of mining practices and the social evolution of Logtown. Archaeology was the primary source for information on organization of activities both in and outside mining claims, how the layout evolved, and the lifestyle choices made in the mining community. While most of the 95 historic-era features and feature concentrations identified were in the boundaries of four patented gold mines, only 38 percent are industrial, while 49 percent are domestic or commercial. Excavations of two buildings pinched between the Pocahontas and Ophir mining claims—in the densest cluster of features that is now Logtown—were related to different phases of technology use. Artifacts from the larger structure indicate a business along the road—possibly a boarding house—that started serving the town when its lode mining industry began to develop; apparently a Victorian-style family household continued occupation of the place during the industry's decline. The other building nearby, set farther back from the road, and incorporating discarded arrastra stone into the hearth, was erected when the local mines were in full swing, likely by a quartz miner with, judging from the assemblage, a chronic ailment or perhaps simply a propensity for "patent" medicines (Tordoff 2005:72); interestingly, both medicine and liquor were absent in the boarding-turned-

townhouse. Research showed that miners who also practiced agriculture resided in the district the longest.

The story of the Felix-Hodson mining district is documented by historians Bill Fuller and Judith Marvin and archaeologist Julia Costello (1996). The history of mining districts is described as one of problem solving: how to remove the ore from the ground and separate the precious metal from the gangue. Over a century and a half, this district struggled with these problems, involving initial placer miners, lode-miners, and rancher-miners, several large mills—including the 120-stamp Royal mill—and a modern open-pit operation. Archaeological excavations were carried out at Maltos' 1893–1930s adobe store and the 1863–66 store and saloon owned by James Howard; in addition, human remains from a ranch cemetery were exhumed for relocation and reinterred. HABS recordings were completed on the mill site. The story – the ethnography – of the mining district and its occupants was published as *Madam Felix's Gold*. As the authors note: "The history of a mining district, however, can be richer than the value of its ore," acknowledging that the personalities and activities of district residents can profoundly influence the course of local mining development. All of the ranchers, their employees, and retainers at some time or another dabbled in mining and allowed the local population to weather the turbulent tides of mining, producing a particularly long-lived mining history.

Gold mining in the Castle Mountains, in the Mojave Desert, is chronicled by 15 years of research related to recent expansion by the Viceroy Gold Corporation (Swope and Hall 2000). Nestled within the mines are the ruins of Hart, a short-lived, early 20th-century mining town. Investigators recognized that no comprehensive history had ever been compiled for the town or Hart Mining District, and so embarked to fill the gap; particularly, they felt the archaeology would refine and expand knowledge on "the sequence of events that took place at the settlement including, but not limited to, periods of occupation, community disasters (i.e., fire), town abandonment and decay, subsequent reclamation of structural and artifactual materials, and more recent industrial development of the locality" (Swope and Hall 2000:27). The investigation succeeded in filling many of the historical gaps, and corrected some of the archival documents' inaccuracies; it also served as an important reminder of the precarious nature of mining sites: "field investigations demonstrate quite clearly the extensive nature of damage to the site caused by decades of relic looting and other past land uses (e.g., clay mining and off-road vehicular traffic)" (Swope and Hall 2000:335).

INDIVIDUALS

A variety of articles by historians described the personal stories of Gold Rush miners, or miners in the period after the Gold Rush. For example, Charlotte Davis and Bernice Meamber's (1980) *Siskiyou Pioneer* article "Henry Levi Davis—Early Builder in Montague" provides a detailed account of Henry Levi Davis, a successful miner/carpenter/investor in the town of Montague in near Yreka. The article covers his accomplishments from his arrival in Yreka to his death sixty-three years later. Others address the experience of a variety of miners, in much the same way as J.S. Holliday (1981) did in *The World Rushed In*. "Life In The Diggin's" (Odall 1972,

1973) provides a number of first hand accounts of life in the mines, which is valuable to developing an understanding of the period. The journal article is a collection of letters from miners in Tuolumne County to their families back home relaying their experiences down to the smallest detail. The first letter is an account of the writer's environment, the situation in the mines and the Indians around him. The second focuses mainly on mining techniques used by the letter writer. Both offer a glimpse of life as a miner. Michael Janicot's (1990) "The Weissbein Brothers of Grass Valley and San Francisco: Banking, Mining and Real Estate," in *Western States Jewish History*, provides a brief history of the professional lives of the Weissbein brothers in Grass Valley. By contrast, Jane Apostol's (2000) *Southern California Quarterly* article "Augustin W. Hale: Hard-Luck Argonaut" notes that while letters from the mines abound, there are comparitively few existing comprehensive journals kept by miners. Hale's is one such example, and Apostol's article recounts Hale's experiences in California and documents his chronic bad luck. The article is composed from Hale's journals and letters home and provides a personal look at the life of a less-than-successful miner.

Historical archaeology contributes depth to the culture histories of particular individuals when a site's material remains can be linked to the actual people who worked and lived there. A good example is Seth and Asa Smith, brothers who left Baltimore to join the Gold Rush, eventually staking out claims in 1854 along McCabe Creek, a tributary of the South Fork Feather River. A series of unpublished letters combined with mining and water claims, other archival sources, and numerous mining and habitation features and artifacts, tell a strikingly rich history of their mining endeavors, and their interactions with partners and competitors (Praetzellis et al. 2006). Partway through their five-year sojourn working the rich bank diggings the younger brother Seth returned home, and the ensuing correspondence between them took on far greater detail, elaborating on the mining methods used, gossip about the mining community, and other rich stories of daily life.

HOUSEHOLDS AND COMMUNITY

Generally the focus of archaeological studies, the household represents a definable unit of measure, whether attributable to a specific individual, group, or family, or associated only to a specific event (e.g., nearby mining feature systems). Attributes of domestic units can be compared between different mining households and residence types.

Early miners were typically transient and their dwellings frequently left only faint traces. Small leveled pads on the hillsides may be the only visible vestiges of tent locations and stone hearths the only indications of dwellings. A few stones in alignment may suggest piers for a wooden floor, although upper walls and roofs were often of canvas. Artifact deposits are similarly sparse. While in much of California habitations are adjacent to mining sites, desert miners often lived by more distant water sources and walked to work. Archaeologists who excavated early placer-miners' cabin sites at Cottonwood Creek noted few material remains, and found that multiple occupations made identification of a specific household difficult (Tordoff and Seldner 1987). For more permanent mining habitations, the artifact record increases.

Sites of mining settlements that have multiple remains of structures hold greater potential for artifact deposits. Two important studies of the gold mining community along Butte Creek, in the northern mines of the Sierra Nevada, were carried out as Master's thesis projects. Daniel Elliot (1995) focused on subsistence and diet in a small mining camp ("Forks of Butte") in Butte Creek Canyon. The 7-acre placer mining complex consists of multiple structures and pads built directly upon and surrounded by placer diggings on both sides of the creek. Excavations focused on a single 1850–1860 deposit from what appeared to be a saloon that had been constructed directly on top of a large placer tailing pile. The deposit yielded over 26,000 artifacts. Questions addressed in the study involve various historical particulars such as age of the deposit and the activity that produced it, as well as a suite of more sophisticated issues including consumption practices, consumer behavior, commodity flow, availability and range of goods, and comparisons with urban deposits.

Jarith Kraft (1998) carried out an exhaustive academic investigation of the second mining site along Butte Creek, involving the 10-acre mining camp named Butte Creek, located across from the town of Centerville. This study focused on eleven mining community property types adjacent to an extensive placer mining landscape of which only a small portion was mapped. Most cultural deposits were less than 6 inches thick; one feature was a burn pit about 25 inches deep, while the rest were either shallow artifact deposits or rock alignments. The remains at each feature were organized differently, but all three contained disposal areas away from the building ruins, demonstrating integrity of horizontal stratigraphy. Analysis of the artifact collection from three loci dating from the 1850s to the early 1900s indicated one locus to be a Chinese occupation, while the residents of the other two appear to have been Euroamerican. Historical research and cross-referencing mining and water claims produced a list of associations. A landscape-based, contextual approach driven by a series of general research issues reconstructed the history of the mining camp. The study succeeds in providing a broad characterization of this small-scale, "fringe" mining community that played a "secondary role relative to other larger regional settlements" (Kraft 1998:501).

Additional discussions of the interpretive potential of mining sites' residences can be found in the Town Sites and Work Camps research designs.

Questions

- What activities/events took place on the site? Was there one occupation or many?
- Was settlement exclusively associated with mining?
- What types of services developed to support the mine and the miners?
- What time period or periods are represented? What was the duration of occupation and mining activity? Are cycles of occupation and abandonment evident?
- Is temporal variation evident within or between loci or feature systems?
- Who lived on the site (numbers, gender, ethnic or cultural group, class, age, known individuals) and did the demography change through time? If so, how and why?
- Is the migration or settlement pattern evident (early transitory or long-term)?

- Is variation in population groups (e.g., family, groups of men, single; class or ethnic segregation) evident within discernable households?
- How did the "life" of this site relate to the locality, the region, broad national events, and the Period?

THEME 3: ETHNIC AND CULTURAL GROUPS IN THE MINES

Popular among scholars of both history and historical archaeology, research under this theme examines multiple facets of ethnicity and discrete culture groups in a mining context. NRHP Bulletin 42, *Identifying, Evaluating, and Registering Historic Mining Properties* (Nobel and Spude 1997), also recognizes "ethnicity and ethnic relations" as important issues.

Of all subjects related to mining addressed in recent periodical scholarship by historians, articles related to race and ethnicity are the most numerous single group. The survey of periodical literature revealed more than 50 articles on the subject, the most common being related to the experience of Chinese (13), Mexican/Hispanic (6), and African American (5) miners. In addition, articles recount the experiences of miners from a variety of European countries or far-off lands. Ten articles focus on the experiences of the French, three on the Cornish, and four on Jewish miners and merchants. Other articles examine the Welsh, Germans, Belgians, Croatians, and Italians. Two address the roles of Native Americans, including Cherokee miners, while another looks at the experience of Hawaiians (Kanakas). The articles examine groups or individuals, and while often offering little specific information about particular aspects of their lifeways (i.e., cultural practices, diagnostic artifacts, etc.) they do provide valuable contextual information related to the variety of ethnic, racial and national groups that made up California's mining community.

Historians have addressed social equality and the role of race, class, and gender in articles over the last 70 years. One such essay was "Unequal Opportunity on a Mining Frontier: The Role of Gender, Race, and Birthplace," by George M. Blackburn and Sherman L. Richards (1993), published in *Pacific Historical Review*. The authors note that while previous historians had examined the demographics of early mining towns to determine the degree of development and changes in social structure, they (Blackburn and Richards) used the same information to determine the opportunities available for social and economic advancement. The authors found that the potential for advancement was, to a large degree, limited by birth, and that the fields of employment open to women, Chinese, African Americans and Native Americans, were limited. Even white men faced barriers. They showed that Chinese and African American men tended to live in town, as did the majority of women, while most white men were scattered throughout the surrounding countryside. Occupations were limited for Chinese and black men, and further limited for women. White men owned the majority of property and were often lawyers, doctors, and merchants. Overall, opportunities for women, Chinese and blacks were relatively restricted.

In "Kanaka Colonies in California," written for *Pacific Historical Review*, Richard H. Dillon (1955) examines the contributions of Hawaiians to the early history of California; Hawaiians

were often called Sandwich Islanders or Kanakas. Such immigrants were often treated with the same distrust and disregard as the Chinese and *Californios*, even though some had been in California before the discovery of gold in 1848. Dillon's article focuses on the treatment and experiences of the Hawaiians in California during the Gold Rush, and makes special note of the Hawaiians' role as missionaries to the Indians. He also observes that Hawaiians quickly assimilated and lost much of their culture.

Charles Wollenberg's (1971) *California Historical Society* article "Ethnic Experiences in California History: An Impressionistic Survey" provides an overview of early California race and ethnic issues, a subject that did not figure prominently in the works of 20th-century historians. His article is a brief overview of the types of discrimination the main ethnic minority groups (Indian, Chinese, Japanese, Mexican, and African American) have experienced in California. Dennis E. Harris's (1984) valuable *Pacific Historian* article, "The California Census of 1852: A Note of Caution and Encouragement," notes the census' shortcomings as well as its strengths and provides a description of what the census covered. The federal census originated as a means to re-align the House of Representatives, and historians have often turned to it to confirm the existence of individuals. Harris showed that the special California census in 1852 quickly became a tool to develop a demographic profile of California and suggests this tool is still valuable today. The article is a reminder that the California census, the only complete one done during this early period, is a valuable and available research tool.

Some of the negative aspects of the racial and ethnic issues are explored in William R. Kenny's (1973) article "Nativism in the Southern Mining Region of California" for *Journal of the West*. Kenny noted that it was commonly known that Mexicans were the subjects of anti-immigrant sentiment in the southern mines, but what was less understood was that they were not the sole subject to this treatment. He focused on the anti-foreign attitudes prevalent in the southern mines, recounting that Chinese and Native Americans faced discrimination along with Mexicans in the area.

The study of culture and culture change is of primary interest to archaeologists and the enormous diversity of nationalities and ethnic groups pouring into the California mines during the Gold Rush and after provides rich material for study. Ethnic minority groups are often poorly documented and therefore information gleaned from their sites may prove important for understanding their history. Distinctive archaeological remains and artifact types can identify the presence of certain of these population groups. Discussed in more detail below, these include mining technologies, domestic cooking features, imported artifact types, and residence patterns. Once the sites are identified, archaeologists can address topics related to cultural continuity and change.

For example, the presence of imported cultural traditions suggests perseverance of homeland traits, while non-traditional activities and artifacts may document both culture change and pragmatic adaptations to the new environment. An example of this is found in Chinese immigrants' artifact assemblages, demonstrating primary reliance on native markets, and selective use of Euro-American products. Distinctive traits of ethnic groups may also change over time, particularly as second and third generations identify themselves as "Californians." The gradual disappearance of the distinctive stone ovens of the Italian

immigrants was dependent not only on acculturation, but on the availability of store-bought bread (Costello 1998:72). Deborah Tibbetts (1997) developed a context specifically for early California gold mining that offered "ethnic markers" for various culture groups.

NATIVE AMERICAN MINERS

A number of articles examined the role of Native Americans in mining. For example, Patricia Cleland Tracey's (2000) *Journal of the West* essay "Cherokee Gold in Georgia and California" points out that there were few accounts of Cherokee miners in the California Gold Rush. Tracey contrasts the experiences of Cherokee miners in California with those who had mined earlier in Georgia. While the article is primarily a comment on the experience in Georgia and the gold rush that began there in 1829, Tracey makes references to California to compare the Georgia experience with a better-known event. "Gold Diggers: Indian Miners in the California Gold Rush," a *California Historical Quarterly*, article by James J. Rawls (1976), notes that while it is common knowledge that California Native Americans were present during the Gold Rush and that some were miners, the extent of their involvement in mining was less known. Rawls addresses this gap—in our understanding of the relationship between whites and Native Americans—in the historic record. He claimed that Native Americans constituted more than one half of miners in California in 1848 and were most commonly employed as workers. In addition, some mined independently. Independent Indian miners usually traded their gold for manufactured goods and food. That Native Americans did not place the same value on gold as whites became a source of unfair advantage to whites, who often sold Indians badly damaged goods for large amounts of gold. As Native Americans came to understand the value of gold to others, however, they became more effective traders and, Rawls remarks, remained honest in their dealings. Native American miners virtually disappeared from the industry by the end of the 1850s owing to the shift in mining from simpler placer mining methods to hydraulic and quartz mining, whose operators did not favor employment of Native American labor.

In Arizona, George Teague (1980) studied two locations of ca. 1900 Papago occupation: a locus at the Reward Mine and a small encampment nearby. Papago were known to have been employed at the mine as laborers and one of the research questions addressed the level of adaptation or acculturation experienced by both Indian and European. The surprising results demonstrated very little by either group. Found at the Papago sites was a "complex of artifacts and features virtually indistinguishable from those found at precontact aboriginal sites in the region" including camp layout, building styles and materials, hearths, domestic ceramic assemblage, and stone working techniques (seven tools were of glass). Adopted traits included a taste for canned meat and soft drinks, although these contributed little to the diet (Teague 1980:146–147). The Papago showed a remarkable cultural stability for this turn-of-the-century time period, particularly as their mining wages would have allowed greater participation in the modern economy. Teague also notes that the American miners similarly adopted only a few of the many indigenous practices which would have made their stay in the arid southwest more comfortable: the ocotillo corral, adobe bricks, and the use of Papago ollas for water storage and cooling.

> It is as if the mines and their facilities were transported wholesale and intact from Michigan or Appalachia to the heart of the American Desert, and this is probably a fair statement of what happened. The result was a raw outpost of mainstream America, expensive to build, and wasteful to maintain [1980:148].

EUROPEAN AND NORTH AMERICAN MINERS

Articles addressing the experience of a variety of European national groups include Mary Powell Flanders' (1983) "From Wales to Manzanita Hill: Eleven Boats, A Wagon and A Mule," published in *The Californians*. Because much of the scholarship on mining centers on the lives of miners from other parts of America, Flanders sought to provide some history of miners from Wales. In the article Flanders uses her great-grandfather's diary as her primary source and provides background from other historical sources. Similarly, George Metcalfe, M.J. Lowry and J.A. Bauer's (1921) *Western States Jewish Historical Quarterly* article "A Memorial for A Blue-Collar, Bavarian-Born, San Francisco Forty-Niner" notes that most accounts of Bavarian-born immigrants focused on successful merchants. By contrast, the subject of this biography was an only modestly successful house and sign painter, and sometimes miner. The article served to broaden the historic record, showing that Bavarian immigrants held many professions. Belgian miners are the subject of "A Belgian in the Gold Rush: California Indians," consisting of the Gold Rush writings of Belgian Dr. J.J.F. Haine, translated by Jan Albert Goris and published in *California Historical Society* Quarterly (Haine 1959). While firsthand accounts of the Gold Rush are not rare, Goris offers Dr. Haine's view, from a Belgian perspective, as an addition to the historic record. His ideas tracked with many other accounts of the mining experience. Haine devotes much of his account to a description of local Native American tribes, focusing on living conditions and wars.

C. Michael McAdams' (1977) "The Croatians of California and Nevada," which appeared in *Pacific Historian*, looks at this immigrant group. McAdams points out that the historical record acknowledged miners from many countries came to California before and during the Gold Rush, but focuses on the Spanish, Mexicans and Americans. McAdams provides some of the history of the Croatian experience. The main stumbling block for documenting Croatian settlers was the tendency of the time to adapt their names first to other European languages, and then to English, which may have led to historians attributing the wrong nationalities to many early Croatian settlers. The article briefly describes the history of Croatians in California; their settlement patterns, similarities of California and Croatia, and the many names they had for themselves. Likewise, Patricia H. Rhodes' (1988) "The Italians of Tuolumne County," in *Chispa*, marks the paucity of information about Italians during the mining period. She notes that among the volumes of literature on the origins of gold miners, little had been said about the ethnic groups who settled in Tuolumne County. Rhodes researched the history of Italians in Tuolumne County, finding that early Italian immigrants to California were primarily merchants in medium-to-large towns, miners, and later, farmers. Ongoing economic crises forced Italians to emigrate to other countries, but the discovery of gold drew them to California with its promise of quick wealth. Most often, Italian men came to California with the intention of going back to Italy. Those that planned to stay, however, came alone and sent for their wives and

families after they were settled and financially stable. These families settled near one another and relied on one another for news and support from home. Rhodes' article provides a general history of the motivations and methods of settlement of Italians in Tuolumne County and California in general.

Cornish were adept at hard-rock mining and brought numerous innovations to California including the Cornish pump, vital for removing water and introducing fresh air into deep workings. However archaeologists have not yet identified key artifacts or features to identify their living or working areas. The contributions of Cornish miners in California and the west was the subject of Paul Friggens' (1978) "The Curious 'Cousin Jacks': Cornish Miners in the American West" in *American West*. Believing that the historical record showed little of the Cornish experience in America, their contributions, their customs and their private lives, Friggens notes that Cornish immigrants were predominately miners and introduced or perfected many mining methods used in America. Elmer E. Stevens' (1964) "The Cornish Miner (from the *Nevada County Historical Society Quarterly*)," presented in *California Historian*, provides a history of Cornish miners in a specific area, in this instance, Nevada County's Grass Valley. The author attributes the success of the community of Grass Valley to Cornish miners. He claims that General John C. Fremont brought Cornish miners to the area to "mine" their expertise. Shirley Ewart (1981) also writes about Cornish miners in the area in her article for *The Pacific Historian*, "Cornish Miners in Grass Valley: The Letters of John Coad, 1858–1860." Ewart notes that when one thinks of the California Gold Rush, one usually thinks first of Americans crossing the continent to reach the gold fields and then of men from other countries and races. She provides the perspective of the Cornish in Grass Valley at the end of the Gold Rush, emphasizing the role of the Cornish family man. Often, men found they could not earn enough as miners to support their families so they took on other tasks useful to the community such as horseshoeing and watch repair, to supplement their mining incomes. The article, focusing on the end of the Gold Rush and the experiences of one Cornish miner, John Coad, stresses most the frustration felt by Coad when he was not able to succeed in California.

Among the most discussed national groups of miners in California were the French who came to the state during the Gold Rush. More than 70 years ago, Rufus Kay Wyllys' (1932)"The French of California and Sonora," in *Pacific Historical Review*, sought to explain why the French were more influential and respected than other immigrant groups. The article discusses both California and Sonora, Mexico. When the French began to come to California from France, they usually came as part of a joint venture company in which they had bought shares. Wyllys discusses this and details the most famous company, the *Societe du Lingot d'Or*, or the Society of the Golden Ingot. French members of this society were commonly known as "lingots." In addition, there was a large number of French who came on their own to California, and by 1851 California had a sizable French population. The French played a large role in the commercial development of San Francisco as bankers, merchants, theatre and restaurant owners, as well as miners. Wyllys noted that many of the French in California went to Sonora at the end of 1851 in search of better opportunities in business and mining. Mexico encouraged French colonists and offered them both military and civilian positions. Wyllys also wrote *The French in Sonora (1850–1854);* a chapter from this book provides a brief history of the French in California. Bereniece

Lamson's (1978) *Pacific Historian* article "The Frenchmen's Dream" addresses the role of the French in early California history from the perspective of the French. Lamson discussed the French motivations for immigration. More than the allure of gold drew the French to California; they also were drawn by potential economic and political opportunities. Opportunities such as these had all but disappeared in France. California was viewed as a paradise where land-starved French could prosper, even if they never found gold.

"The Lucky Frenchmen of the Yuba," Claudine Chalmers' (1994) article for *The Californians*, gives a detailed account of the lives of three particular Frenchmen who had three very different experiences in California, providing evidence that the California experience varied greatly for French immigrants. Chalmers explains that the success of her subjects was caused in large part by the low number of people working the Yuba area for gold and the willingness of Native Americans to assist with the labor. Chalmers also prepared an introduction to the journals of Alphonse Antoine Delepine, presented in *The Californians* as "'A Soul Lost in the Wilderness': Tales of a French Argonaut, Part I" (Delepine 1988a) and "'Among an Eminently Warlike People': Tales of a French Argonaut, Part II" (Delepine 1988b). Chalmers' introduction provides a short history of both the French in California and Delepine's experiences. W.W. Kallenberger's (1954) "The French in Nevada County's Early History" for *Nevada County Historical Society* examines the Gold Rush endeavors of six Frenchmen and one Belgian. Nevada County had a large population of French. Many were miners who specialized in hard rock mining. He notes the particular skills in mining and engineering that these men displayed, and concluded that the reason the French were primarily miners and not farmers was caused by the organization of societies in France that recruited miners rather than farmers.

Gilbert Chinard (1943), in "When the French Came to California: An Introductory Essay," written for *California Historical Society Quarterly*, opines that historians seldom investigated the reasons why men emigrated to California. He used the example of one society organized for immigration to explain some of their motivations, Chinard pointed out that after the fall of France's July Monarchy in 1848, organizations formed to provide orderly direction of undesirables of every class and profession to French colonies. When the news of the gold discovery reached France, California became a destination as well. An aspect of California that was particularly appealing to early immigrants was the lack of organized government, a factor that led the French to hope they could carve out a portion for themselves.

The experience of African Americans during and after the Gold Rush is another major topic for historical research. One example, Albert S. Broussard's (1985) "Slavery in California Revisited: The Fate of a Kentucky Slave in Gold Rush California," in *The Pacific Historian*, finds that the historic record did not focus on slavery in California gold mines. Broussard shows that California was not seen as a land of freedom and opportunity by slaves brought there by their masters. He maintains that in the west they found a lack of community, as few African Americans, free or slave, were in the mining camps. The independence that slaves were granted in California was also not taken as a change in their status. This view was noted two decades earlier, by Rudolph M. Lapp (1966) in the *California Historical Society Quarterly* article "Negro Rights Activities in Gold Rush California." Lapp found that there had been only limited historical discussion about African American rights activities before the Civil War, and less

about African American civil rights activities in California. Lapp's article discusses these activities in California to illustrate that African Americans were, in fact, active in securing their rights. Additionally, Lapp recounts the hurdles they surmounted to obtain and preserve their freedoms. He points out that not only were there many free African Americans in California fighting for legal freedom, there was also cooperation between whites and blacks. The article covers issues such as the Fugitive Slave Act, the First Colored Convention in 1855, organization in 1852 of the Franchise League that sought to change laws prohibiting African American testimony, the 1858 attempt to bar African American immigration, and the African American exodus to Victoria, Canada, in 1858. Lapp closes with the positive shift in fortune for African Americans who remained in California. In "The Negro on the Mining Frontier," written for *Journal of Negro History*, W. Sherman Savage (1945) notes that much of the scholarship on the Gold Rush stated there were few African Americans in the mining camps. Savage shows that there were, in fact, many African Americans in the California Gold Rush and later. Savage provides examples of free and slave African American miners in California, and discusses the prejudice they encountered as examples of cooperation between master and slave. Savage notes that many African Americans did not work in the mines, but remained in camp or in town and took jobs there.

Historian Otis E. Young (1980) addresses the impacts on the mining experience by U.S. immigrants in his *Southern California Quarterly* article "The Southern Gold Rush: Contributions to California and the West," which explores the contribution to California mining made by miners from the southern states. Young's article contains a number of very brief accounts of discoveries of gold across the country, and discusses the influence of contributions made by skilled southern miners, often forgotten in California, by examining the census statistics of states last resided in and the names of mining camps.

Three articles address the role of Jewish merchants and immigrants in the Gold Rush. While not directly related to mining, both Muriel Weissberg's (1986) "Pioneer Jewish Merchants of the Gold Rush Period In and Around Shasta," in *Covered Wagon*, and Dr. Robert E. Levinson's (1971) "The History of the Jews of Grass Valley, Nevada City and Vicinity," in *Nevada County Historical Society*, discuss the role of Jewish merchants in mining communities. In addition, Levinson's article describes Jewish societies and organizations, and the role they played in the county. Al Weissberg's (1985) *Covered Wagon* article "Pioneer Jewish Families of Shasta County," provides an account of the first Jewish settlers to Shasta County.

With a few exceptions, archaeological sites of Euro-American miners do not carry distinctive archaeological markers that allow researchers to distinguish particular ethnic or national sub-groups. Stone bread-baking ovens, however, have provided a key to identifying cultural groups adhering to the Mediterranean tradition of baking bread in domed ovens. Without specific documentary and oral-history associations, however, the attribution of archaeologically found ovens to specific groups is dependent on determining which group was most populous in the area at the time the ovens were constructed.

Italian domestic sites were identified in the Mother Lode by Julia Costello (1981, 1998) using oven remains as clues. Excavations of the habitation sites of the placer miners along Angels Creek in Calaveras County yielded meager artifact assemblages. However, using some

diagnostic bottle fragments to provide an 1870s time frame and with mining identified as the occupants' vocation, the 1870 census was analyzed to establish when the census taker was in the vicinity of the sites, between known ranch households. The Italian association of the sites was thereby determined, and the surprising presence of these formidable constructions on otherwise rudimentary living sites observed. The clustering of these late-coming Italian miners along a creek demonstrates the propensity of foreigners to band together, and use simple placering technologies to extract the limited economic resources of this locale.

The association of stone bread ovens with Italians is not exclusive, however. Of 55 documented stone ovens in Amador, Calaveras, and Tuolumne Counties, 42 were associated with Italian immigrants. The remainder represents the French (5), Chilean (4), Mexican (2), Corsican (1), and German (1) nationalities (Costello 1998:72). This bias toward Italians is due to the unusual concentration of those immigrants in this region. In other parts of the State, where other nationalities with cultural roots to the Mediterranean are more numerous, stone ovens may indicate the presence of other ethnic groups. Priscilla Wegars (1991) associated ovens alongside the railways in Idaho with an Italian workforce verified in documentary records. Ovens associated with Mexican miners are discussed below.

Newland et al. (2006) used mining and water claims and the population census to attribute ca. 1860s domestic and placer mining feature systems to Portuguese immigrants. Although not part of the Gold Rush, these so-called New Immigrants (like the Chinese discussed above) used similar methods decades later, including sluicing and small-scale hydraulicking, to help secure a livelihood in the Feather River goldfields. The investigation further demonstrated that contemporary American miners upstream sluiced in a different manner, resulting in a different tailings configuration.

Patrick Martin (1987) uses years of experience examining heavily capitalized mines in Michigan's Copper Country to show how archaeology exposes information about ethnicity and daily life. Evidence in the domestic artifact assemblage demonstrated ethnic segregation of a Swedish mining community working for the Quincy Mining Company. The types of pipes and pottery used in Swedetown indicated to Martin that ethnic conservatism is often evident in the area of foodways (Martin 1987:98).

LATIN AMERICAN MINERS

The role of miners from Spain's former New World empire has been the subject a wide variety of articles. For the purposes of this discussion, articles regarding the role of *Californios* in the Gold Rush are included with other works related to Sonorans, Mexicans, and Chileans. Many of the articles focused on relations between miners from these areas and those from the United States.

Duane Hale (1979), in "California's First Mining Frontier and Its Influence on the Settlement of that Area," published in *Journal of the West*, addresses the small-scale mining that went on in California prior to the Gold Rush. Hale discusses the mining that went on during both the Spanish and Mexican periods of California's history, and notes that gold was

discovered in small quantities numerous times from the Bear Flag Revolt to Marshall's discovery of gold in 1849, but little attention was paid to it.

Carlos U. Lopez's (1988) "The Chilenos in the California Gold Rush," in *The Californians*, examines the effects of gold fever on Chilenos, many of whom came to California early in the Gold Rush. Of those Chilenos who came to California, the majority worked as miners, while some became merchants. Chileno miners, bringing with them a wealth of experience from home, were known for their role in teaching American miners mining techniques. Lopez claimed that Chilenos were hated by American miners because of their refusal to be intimidated. This stubborn resolve evoked competing feelings of fear and respect. More than half of the Chilenos returned home by the 1850s, but a large population remained in California.

The contentious relations between Mexican and American miners was addressed by Richard Henry Morefield's (1956) *California Historical Society Quarterly* article "Mexicans in the California Mines, 1848–1853.", Finding that much of the scholarship about the conflict between Mexicans and Americans in the mines centered on the experiences of Mexicans immediately before and after the passage of the Foreign Miners' Tax, Morefield examines what led to the passage of the Tax, in addition to its effects on Mexicans in California. He stresses that the national concern for establishing the rights of American citizens in California led to passage of the Foreign Miners' Tax and fostered anti-Mexican attitudes in the mines. Morefield claims the primary goal was to ensure that a large portion of California gold remained in the U.S. and the rush of foreigners to the mines threatened the success of this policy. He provides an interesting contrast in the view of Americans and foreigners as seen from the perspective of merchants. Merchants preferred foreigners to Americans because foreigners, primarily Mexicans and Chileans in this account, spent their newfound wealth freely, while Americans spent as little as possible and left the state with it as soon as they could. While couched in the framework of anti-Mexican sentiment, the article is really about anti-foreign sentiment. A similar article in *Journal of the West* by William Robert Kenny (1967), "Mexican-American Conflict on the Mining Frontier, 1848–1852," notes that scholarship regarding conflict in the mines usually focused on racial tensions and fails to address the reason why certain ethnic groups preferred one area to another. Finding a clear difference between what happened in the northern (i.e., north of the American River) and southern (i.e., the area between the American River and Mariposa) mines. Kenny states that the northern mines usually had a predominance of Americans with relatively few foreigners. The southern mines, in contrast, had a greater percentage of foreign miners. Kenny provides several potential reasons for this, including the region the miner came from and its relation to the mines, preferences in climate, and the reception by miners already in the area.

Historian Richard H. Peterson wrote three articles that bore on the often-contentious relations between Mexican and American miners. His 1976 *Pacific Historian* article, "The Foreign Miners' Tax of 1850 and Mexicans in California: Exploitation or Expulsion?" notes that discrimination suffered by Mexicans in California during the Gold Rush was well-documented. He stresses how the Foreign Miner's Tax reinforced this discrimination, and posed two reasons why it passed: was it to expel, or exploit, Mexican miners. Peterson contrasts the view that the tax was designed to exploit foreign miners and protect Americans by blocking foreign

capitalists, with the view that the tax was designed to expel foreign miners, namely Mexicans. He maintains that the latter view had the strongest evidence; Mexicans were skilled miners and thus were often times more successful than American miners, who feared that gold would run out, and feared the large population of Mexican miners. In Peterson's view, these factors fueled anti-Mexican sentiment and strengthened the movement to expel them from the mines. His 1980 article for *Southern California Quarterly*, "Anti-Mexican Nativism in California, 1848–1853: A Study of Cultural Conflict," notes that while most scholarship about Mexicans in California mines focus on local economic conditions and conflict, these issues were a result of pre-existing anti-Mexican attitudes. Peterson describes the rush of Mexicans to California that began soon after the discovery of gold. Most were experienced miners who were willing to teach Americans how to mine. As early as April 1849, however, anti-Mexican sentiment chased Mexican miners from their claims. He also addresses imposition of the Foreign Miners' Tax, persecution of Mexican miners, anti-Mexican hostility seen throughout the state, and how these related to the American idea of Manifest Destiny. Finally, his 1985 article in *The Californians*, "The Mexican Gold Rush: 'Illegal Aliens' of the 1850s" added to our understanding of the relationship between American miners and Mexican miners by discussing the experience of Mexican miners after the passage of the Foreign Miners' Tax in 1850. Peterson describes the initial effect the Foreign Miners' Tax had on Mexican miners, the continued effect it had after its repeal one year later, and the results of its reinstatement the next year. Additionally, he discusses the effect of discrimination and concludes that it was caused, in large part, by the success of Mexican miners. Other factors included the ease with which the Mexican-American War was won, the poor treatment of Americans in Mexico, and the belief that white Americans were racially superior. Historian Otis E. Young's (1965) "The Spanish Tradition in Gold and Silver Mining," in *Arizona*, notes that history often remembers the Spanish as conquerors searching for the gold mined by others. Young points out that the Spanish were skilled miners and later American miners benefited from these skills. Spanish miners were skilled and hardworking, but sought gold and silver that was relatively easy to obtain given their limited technological base. They relied heavily on Indian labor and tended to abandon mines when the metal began to run out. Young's article discusses mining techniques, purification techniques, and treatment of Indian laborers.

One of the most extensive studies of Mexican mining sites was the thesis completed by Trish Fernandez (2001): *Mexican Miners in the California Gold Rush: a Historical and Archaeological Study*. In it, she provides an excellent context for this topic and summarizes archaeological studies on these and similar mining sites. The majority of Mexican miners worked in the Southern Mines, along the Mokelumne, Stanislaus, Tuolumne, and Merced River watersheds. Arriving in force from Sonora in 1848, their numbers peaked in 1850 and then declined rapidly following implementation of the oppressive Foreign Miners' Tax. Her study of locations of Mexican mining camps of "Lower Calaveritas" in Calaveras County consisted primarily of archival research, oral histories, and field survey and recording. Evidence was persuasive that she had found the locations of the fabled camps but excavations were recommended for final verification. The two primary settlements included remains of adobe structures, stone building walls, large stone-fenced enclosures, two stone ovens, and artifacts consistent with Gold Rush occupations. The larger site was later occupied by Frenchmen who ran the "fandango" house

that entered local legend. Spanish place names were a more enduring legacy of the Mexican miners than their short-lived camps.

While yet untested, sites of these Sonoran miners should be distinguished by artifacts representing a settlement of families in contrast to the nearly all-male camps of virtually all other early miners. Prejudices also segregated Mexicans. As part of the New Melones project studies, historians W. Turrentine Jackson and Stephen D. Mikesell (1979a, 1979b) identified the Mexican town of Melones (namesake for subsequent mines and reservoirs). Archaeologists verified its location along the flanks of gold-rich Carson Hill, recording arrastra stones from their milling operations (Costello 1983:12–18). Later, evidence of Mexican miners was found within the residence district of the riverside mining town of Melones (distinct from Mexican Melones discussed above). The residence area for Mexicans in the workforce is suggested by an artifact collection recovered from a privy and cellar, dated from 1890–1910, and containing two shards of Mexican Tlaquepaque Polychrome, a 1903 Mexican centavo, and a bottle of liniment "ACEITE/MEXICANO" (Fitting et al. 1979; Greenwood and Shoup 1983:59; Fernandez 2001:47). At this late time period, the distinctive imprint of a Mexican workforce in the Mother Lode appears faint.

However, in the farthest corner of southeastern California, in the Cargo Muchacho Mountains, Mexican family neighborhoods were identified as the adjacent Hedges/Tumco and American Girl mines. Operating from the 1890s through the 1930s, tailings from milling gold ore filled the valley floor. Extensive study of the Hedges/Tumco mining site was carried out by Michael Burney, Stephen Van Wormer and others (1993). A segregated Mexican neighborhood called "Adobe Ridge" was identified as being made up of primarily adobe and *jacal* (posts with twined branches packed with mud) structures, with some stone buildings. The jacal structures are distinctly Mexican, additionally having typical packed earth or adobe floors or adobe pavers and roofs of earth packed over branches. Artifact collections indicated that the occupants adhered to traditional dietary practices, distinct from their Euroamerican neighbors. This pattern was also seen in an adjacent Mexican mining camp at the American Girl mine, excavated by Susan Hector, Jim Manley, James Newland, and Stephen Van Wormer (1991). In general, at the Mexican camps less canned milk was consumed, countered by higher use of pepper sauce and spices. Ceramics include significant quantities of Native American buffware and lead-glazed Mexican wares. Beef was the preferred meat—boiled or stewed—and bones were more apt to be cleaver-cut than hand-sawn (Fernandez 2001:63–64).

While domed stone ovens may be associated with several Mediterranian-based cultures, the *asado* may be distinctly related to early miners from Chile and other Spanish speakers. It consists of a semi-circular stone wall about 10 feet across, 7 to 10 feet high, and nearly 5 feet deep. Serving as a type of barbecue, sides of meat were leaned against the wall, roasted and smoked by a small fire built against its base. One of these has been identified along with a domed oven and camp site next to placer-mining remains on the Calaveras River (Marvin 2005). The feature is common today in the ranchlands of Argentina, and may be the purpose of the enormous "fireplace wall" identified at the Basque adobe at Los Vaqueros (Ziesing 1997:101–103, 200).

Arrastras and Chilean Mills were imported by Mexicans and Chileans and adopted by other miners as low-cost milling tools that could be constructed out of materials at hand. Their prima facie association with Mexican mining cannot be made unless other evidence supports this conclusion, as with the arrastra at Mexican Melones mentioned above. Arrastras continued to be used occasionally into the 20th century, built of modern materials and used as an expedient form of ore reduction for enterprises with minimal financing: they exemplify modern adaptations of an early technology (see discussions above).

Some adits of Mexican miners have been identified with carved niches in their walls for religious icons. At Carson Creek in Calaveras County two niches (18 × 18 inches × 5 inches deep) were found 8 and 10 feet from the entrance, approximately 3 feet above the ground (Greenwood 1982:61). They correspond to a description by Borthwick of a nearby mine at Carson Hill: "Numerous small wooden crosses were placed throughout the mine, in niches cut in the rock for their reception, and each separate part of the mine was named after a saint who was supposed to take those working on it under his immediate protection" (Borthwick 1997:74 in Fernandez 2001:46). Similar niches were found at the New Almaden mine at the location of Mexican workings (Fernandez 2001:241).

CHINESE MINERS

Among the groups generating the most interest of historians were the Chinese who came to California during and after the Gold Rush. One of the earlier articles on this subject was David V. DuFault's (1959) "The Chinese of the Mining Camps of California: 1848–1870," in *Historical Society of Southern California Quarterly*. DuFault notes that strong movements to remove the Chinese from their mining claims began in earnest in 1852 and continued through the end of the 19th century. Miners often feared loss of their employment to Chinese who would work for less, according to DuFault, as well as fearing an unknown culture and religion, and that mass immigration that would overpower Americans in California. He also provides a brief history of the lives of the Chinese in mining camps; their penchant for gambling, preferred foods and entertainment, religious beliefs, and conflicts within the group. Liping Zhu's (1999) article in *Montana Magazine*, "No Need to Rush: The Chinese, Placer Mining, and the Western Environment," points out that while it is well known that the Chinese were among the many ethnic groups flocking to the west during the Gold Rush, there is little known about the contributions made by them at that time, specifically why the Chinese were more successful than others in placer mining. Zhu examines the Chinese in California as an example, concluding that the Chinese were drawn to California not only by gold, but in reaction to the ravages of thirteen years of civil war in China.

The voyage across the Pacific took only six weeks, and soon there were more than 30,000 Chinese in California. In the ensuing years more followed, and Chinese miners spread throughout California, Nevada, Oregon and Washington. Chinese miners came from a long tradition of working in foreign lands through fraternal-like economic companies (Tongs) and were able to use this to their advantage when staking and working claims. They also commonly created private gardens that provided ample greens for their own use, as well as extra for sale.

The Chinese had the expertise of their own doctors to maintain their health, and the health of other local miners. Finally, knowledge of water systems brought with them from China helped manage the scarce water supply often found in mining sites and ensure enough was available for their use. Zhu reports that the advent of hard-rock mining, and the Chinese Exclusion Act, forced many Chinese out of mining. In a similar vein, Shih-Shan Henry Tsai (1988) in *The Californians*, writes of "The Chinese and 'Gold Mountain'," an examination of Chinese immigrants who came to California as well as those who traveled beyond California to work for wages. After the Civil War, southern plantation owners recruited Chinese immigrants in the hope they would replace the newly-freed slave population. Railroad builders hired them as cheap labor. Of course, California miners used them for their skills and patience in mining. Chinese immigrants worked willingly, but Tsai shows they were quick to leave if they feared they were not being dealt with honestly or they would not be paid. Because most Chinese immigrants could not speak English, their employment was arranged through a broker. The broker was paid directly and he distributed the wages to the workers. Tsai notes the Chinese persevered through the anti-Chinese laws, such as the Foreign Miner's Tax and the Chinese Exclusion Laws, and came to be regarded as honest hard workers.

Other articles focus on the experience of the Chinese in specific locations. For example, William A. Jones (1986) describes "Yreka's Chinese and the Great Flood of '90" in *The Californians*, providing and interpreting photographs of the Chinese. Jones gathered and studied the collection of photographs from Dr. Charles R. Larison, who recorded the flooding of Yreka Creek and the resulting destruction of Yreka's Chinatown. He provided a brief history of the Chinese in Yreka and the flood in February 1890 that led to the departure of the majority of the Chinese living in the town, as well as seven photographs of the period immediately before and after the flood. Likewise, Dolores Yescas Nicoline, Richard Yescas and Roberta M. McDow's (1972) "Chinese Camp," in *Pacific Historian*, sought to document the little town of Chinese Camp. The authors discuss the elements of the town that could still be viewed in 1972, and recount settlement of the town by Chinese miners, mining in the area, the so-called Tong War, and the development of a permanent settlement. A closer view of the Chinese experience in Shasta County was provided in "Chinese Chronicles of Shasta County" by the Shasta County Historical Society (1985) in their journal, *Covered Wagon*. Noting the substantial documentation of the Chinese in Shasta County, the Society presents a short history of this group and their customs, and includes a time line composed of newspaper articles reporting on the arrival of the Chinese to the county, and subsequent happenings there, including their work on the railroad. Beverly Barron's (1974) "The Celestial Empire," in *Chispa*, provided a collection of anecdotes about the Chinese in California and in Tuolumne County. Included are accounts of mining, cooking, living conditions, entertainment and persecution, and the reminiscences of two long-time residents who remembered the Chinese in the county. Ronald H. Limbaugh's (1993) article, "The Chinese of Knight's Ferry, 1850–1920: A Preliminary Study," in *California History*, describes the Chinese who lived in and around Knight's Ferry in Stanislaus County, and the effects of anti-Chinese sentiment. Limbaugh also covers Chinese-owned and -operated businesses in Knight's Ferry as well as professions (doctor, lawyer, etc.) held by the Chinese. His analysis ends with an examination of gender, age and taxpayer rolls in Stanislaus County. In a brief *Nevada County Historical Society* article, "Nevada County's Chinese in Two Parts: Part

I-Prior to 1900," Patrick Tinloy (1971) described the arrival and early history of the Chinese in Grass Valley and the attitudes toward them.

Andrew Johnston (2004), in "Quicksilver Landscapes: The Mercury Mining Boom, Chinese Labor, and the California Constitution of 1879" (*Journal of the West*), describes the legal difficulties faced by some employers by the violation of an article in the California constitution of 1879 that provided no corporation could hire Chinese or "Mongolian" workers. Tiburcio Parrott, president of the Sulpher Bank Quicksilver Mining Company, was arrested for employing one Chinese worker, an act done to challenge the provision in the new state constitution. Johnston uses this example to discuss the battle over cheap Chinese labor, which eventually became a national issue and culminated in new, restrictive Chinese immigration laws.

Finally, a summary of the Chinese mining experience is found in Randall E. Rohe's (1982) *Montana* article, "After the Gold Rush: Chinese Mining in the Far West, 1850–1890." Rohe suggests that the historic record addressed the predominance of white Americans in mining camps but paid little attention to the Chinese in these camps. Rohe discusses the role of Chinese miners in the mining regions of the West, focusing his article on the role of foreign miners in the California Gold Rush. He averred that foreign men replaced American miners after the initial rush, and in placer mining areas, replacement miners were usually Chinese. Rohe claimed that historians' common emphasis on discrimination in the mines obscured the importance of Chinese miners on the frontier. He believed that the Chinese complemented white miners and slowed population decline in mining areas abandoned by others, spent a large portion of the gold they found in their local economies, and paid their share of taxes. A later Rohe article contests the conception that Chinese miners "consisted entirely of small-scale, primitive mining techniques," and suggested that archaeology is in a position to help investigate the extent of mining habits by various groups (Rohe 1994:73).

Roberta Greenwood (1993) summarized the status of archaeological studies of Overseas Chinese at the time, in a chapter of Priscilla Wegars' (1993) edited book *Hidden Heritage, Historical Archaeology of the Overseas Chinese*. In it, Greenwood describes how previous studies had primarily focused on identification of Chinese material culture and reconstruction of Chinese lifeways in the land known as *Gum San* (Golden Mountain, or California). She calls into question the assumption of a linear process of "acculturation", as well as the characterization of Chinese in California as "sojourners"—temporary workers who planned to return to homelands. This oversimplified a complicated history where many Chinese returned home because of being driven out by discrimination, or remained to begin new lives. The history of the Chinese in the mines was seen as similarly complex, but the first order of business was to simply identify the locations and nature of their largely unrecorded camps.

Sundahl and Ritter (1997) investigated two miners' habitation sites situated in heavily mined areas near Redding. One site contained the remains of a cabin with a collapsed chimney and stone footings; the other site contained a substantial hearth-like feature. The assemblages indicated 1865–1870 and 1870–1880 occupations by Chinese placer miners "cleaning up the auriferous remains from high-grading Euro-American miners who were also in these drainages" (Sundahl and Ritter 1997:67). The authors discuss the the possibility that the earlier

site represents Chinese placer miners reusing an existing Euroamerican cabin, while the post-1870 site represents more traditional Chinese settlement. Peter Bell (1998:33) found hearth-like features like the one from the Sundahl and Ritter traditionally Chinese site, describing them as "knee-high structures of earth and stone, one to each hut," only on post-1870 Chinese mining settlements in Australia. He links the feature types to a substantial increase in Chinese immigration. Before 1870 the Chinese in Australia made up between 15 and 25 percent of the mining population, while after 1870 it was over 50 percent, and at times over 70 percent. He notes that earlier Chinese miners "lived exactly as European miners did: at first in tents, then mostly in sawn timber huts with iron roofs" (Bell 1998:33), attributing the absence of the hearth features typical of later decades to earlier abandonment of traditional practices. The pattern suggests to Bell that "there is a threshold proportion of population below which a particular ethnic group is lost in the background, but above which the group can successfully preserve its material culture" (Bell 1998:33).

Tordoff and Seldner (1987) investigated 13 sites in Shasta and Tehama Counties that, like those of Sundahl and Ritter (1997), demonstrated perhaps the major problem in distinguishing artifact assemblages of Chinese miners: that the Chinese tended to re-occupy not only the diggings but the habitation sites of the Euroamerican miners. Due to the short time periods of occupation, the artifacts from both groups are generally merged into one strata of sheet refuse around the dwelling, impossible to separate. The artifact collections from the 13 sites at Cottonwood Creek revealed a typical repertoire of Chinese items, particularly ceramic tablewares and food jars indicating use of traditional foods. Opium-related items, gaming pieces, and medicines were also imported from China. Also present were American ceramics, can fragments, nails, horse tack, liquor bottles, and mining tools. While the Chinese are clearly identified by their artifacts, the non-Chinese artifacts could have been used either by them or by earlier Euroamericans. The same problem of overlapping occupations was noted by Tordoff and Maniery (1986) on other mining sites in California. Sisson's (1993) work with Chinese mining sites along the lower Salmon River in Idaho ran into similar problems identifying habitation sites with exclusively Chinese occupants. His study of vernacular Chinese architecture indicates that miners' dwellings might be distinguished by rammed-earth construction, chimneys near doorways, or rock-wall enclosed rock shelters (Fernandez 2001:36).

A distinctive "hairpin" shaped stone stove appears to be exclusively related to Chinese sites and has been identified in both the Mother Lode (Costello et al. 1998) and on abalone fishing sites on San Clemente (Berryman 1995). Consisting of two long, parallel arms between 3–11 feet in length spaced about 2 feet apart, the fire is in the enclosed trough and the cooking vessels span the arms; a chimney may be located at one end. A Gold Rush sketch shows one depicted in a mining camp (De Long 1929:349). More precision in describing stone features on sites may help identify additional examples of these unique Chinese cooking stoves. Other distinctive Chinese cooking features—wok ovens and cylindrical roasting ovens—are indicative of established Chinatowns in urban areas (Costello 1999; Medin 2002; Costello et al. 2004).

Jeffrey LaLande (1983) addressed a popular notion reiterated by Rohe (1986:150) that Chinese placer miners followed after expedient Euroamericans and meticulously reworked abandoned claims. Although in general this historic pattern is true, a common misconception is

that therefore all neat and tidy, stacked-rock placer remains were created by Chinese miners (e.g., McGie 1956:78). These are commonly called "Chinese walls" across the West. A number of archaeological investigations have struck down this persistent notion, and recently these contributions made by historical archaeologists are finding their way into the historical literature (Limbaugh 1999:30). LaLande (1983), for example, studied thirteen large documented hydraulic placer mining sites in the Siskiyou Mountains of Oregon and confirmed Euroamerican and Chinese associations for three and six of them, respectively, based on archival documents and artifact classes. Finding that both Chinese and Euroamercian miners produced neatly stacked rock walls and amorphous piles, he argues that they "should not be taken as prima facie cultural evidence" (Lalande 1983:6).

Archaeological excavations at a 13-acre placer mining complex in Sacramento County provided data on the site's placer miners (Maniery and Brown 1994). Surface features included placer tailings, ditch segments, rock alignments, six circular stone hearths, and artifact deposits. Three spatially discrete, historic-era occupations were defined, including an 1850s Gold Rush-era component, a Chinese occupation beginning in the late 1860s, and a Euroamerican presence starting a decade or so later. Although archival documents show large numbers of Chinese miners in the region through the 1880s, the material culture at this site shows that here Euroamerican placer miners edged their Asian competitors off potentially rich deposits in the mid-1870s, in conjunction with the rise of anti-Chinese sentiments. Field data also showed the enduring use of sluice technologies long after the Gold Rush.

Questions

- Are there archaeological markers of an ethnic/cultural group occupying the site (distinctive features or artifact types)?
- Is there documentary evidence of ethnic/cultural occupation of the site or the vicinity? Is there a historic context for the presence of this group and identification of their immigration and work history? What links were in place with the homeland (for example: Chinese Tongs, chain migration)?
- Is there other evidence of this ethnic group in the vicinity or region? Was the site isolated or part of a community?
- What is the time period of occupation? How many people occupied the site (reflected in domestic features)? What were their demographics?
- Were there multiple occupations of the site? Periods of abandonment in between? Did specific groups mine the site sequentially (e.g., Chinese re-working previously-mined deposits)?
- Were the site occupants independent workers or employed by a mining company/enterprise?
- How did the miners organize themselves? How did organization change through time for various groups of miners?
- How was space organized: sleeping areas, cooking areas, work areas, refuse disposal?

- Is there evidence for the type of structures that may have been present?
- How does the evidence for ethnic groups on this site compare to similar sites? How does it compare to Euroamerican sites of the same time period?
- What continuities of traditional culture are evident? What has been adapted from the dominant Euroamerican or other cultures? What innovations are present?
- What types of mining methods were employed by distinct groups through time, by region, and for different mineral types?

THEME 4: WOMEN AND FAMILY

The history of women as pioneers, mothers, wives, and miners, during the Gold Rush and after, and their roles as developers of the general economy of California and the West, has been the subject of a variety of scholarly studies during the past years. Noted Gold Rush historian J.S. Holliday's (1957) paper "The Influence of the Family on the California Gold Rush" points out that scholarship of the Gold Rush usually focused on the individual, as most men came to California without their families, and either sent for them or returned to them later. Holliday urges us not to forget the role of those families that the men left behind. A great many men left their families not out of greed or a selfish desire to begin again, but out of a duty to provide for them. The Gold Rush, to these men, was not a gamble; it was an opportunity not to be missed. Women and children remained home primarily because the men were planning to return quickly. Those that decided to remain in the West often sent for their families as soon as they had established a somewhat permanent home.

It has often been thought that women were virtually non-existent in the gold fields during the Gold Rush. JoAnn Levy's scholarship, in articles and books, describes the roles and contributions of women. Her 1988 *Overland Journal* article, "We Were Forty-Niners Too! Women in the California Gold Rush" notes that there were, in fact, many women bitten by the gold bug and they traveled in great numbers (though fewer than men) to California in search of their fortunes. Levy shows that women did a little of everything, from cooking, laundry, to running boardinghouses, mining, prostitution, and and a range of other occupations. She discusses the experience of women both in traveling to California in wagon trains, and their life in the gold camps. Women sought first to care for their families on the journey, then to build a home, and finally to make money. They had opportunities to make money during the Gold Rush, and found they were justly compensated for their efforts. Cooking, washing and mending, or running a boarding house or restaurant were the primary pursuits, but owning businesses such as a theatre, barber shop, photography studio or mercantile were also common. Only about one in five women were prostitutes, and often these were drawn to it for economic necessity, rather than the common misconception they were forced or tricked into it. Levy's (1992) book *They Saw The Elephant: Women in the California Gold Rush* provides additional information on the many female Argonauts rushing to find gold side by side with men. She shows that women were not just prostitutes and boardinghouse keepers, and that they often took jobs formerly reserved for

men. Additionally, women were often quite willing to travel to California and many were eager miners.

In his *Pacific Historian* article "Proper Women at the Mines—Life at Nevada City in the 1850s," David A. Comstock (1984) shows that while women in mining towns were often stereotyped as prostitutes and other "hard luck" women, there were plenty of "proper" women in mining towns. Comstock notes that women were able to maintain their moral standards even when faced with the crudeness of a mining town. Using the letters and journals of a woman in Nevada City as an illustration of these larger issues, he provides examples ranging from the lax attitude toward religion to the offensiveness of the town shopping district with its mix of mercantile, saloon, shop, and prostitutes. Comstock also addresses the rough quality of both men and women in mining towns and the struggle of women to maintain their standards.

Annegret Ogden (1986) also addresses these issues in "The Frontier Housewife—Stereotype vs. Reality" (in *The Californians*). She notes that when one thinks of the image of a frontier housewife, it is usually one of a hardworking, deferential, yet strong woman who offers her unconditional support in whatever her husband seeks to accomplish. Ogden shattered that image. She shows that women played a powerful role in maintaining the family, and contrasts the common concerns of women to those of their husbands. Men, in Ogden's view, were concerned most with gold and how quickly they would get it, while women focused on the dangerous journey, the toll it would take on their health, and the difficult living conditions to be faced. The perceived role of women was not to open the West but to follow after to settle and populate it, and as such, women had to be prepared not only to handle the affairs of the household but to bring in extra income to help support the family. They did this by selling milk, butter, eggs, and poultry. If a husband proved unable to support his family, a wife often turned to divorce to better her chances of survival. These matters were also explored in Robert C. Griswold's (1980) "Apart But Not Adrift: Wives, Divorce, and Independence in California, 1850–1890" in *Pacific Historical Review*. He reports that when a study was done of a Gold Rush town and its inhabitants, the rate of divorce was often overlooked. Griswold shows there were real legal options open to women wishing to end their marriages, and uses divorce records in San Mateo and Santa Clara Counties to illustrate his view that the majority of women did not fit the Victorian stereotype. These records demonstrate both the options for women to end a bad marriage, and that courts were often sympathetic to them. Divorced women could take comfort in knowing they could put their domestic skills to use to support themselves.

In the *Journal of the West* article "Women and Mining in the Old West," Margaret S. Woyski (1981) takes on the stereotypes of miners as men, and of women in mining camps as cooks or prostitutes. Woyski looks at the contributions of women to mining, from staking a claim or financing one, to providing the domestic labor to keep the mining camp running. The arrival of wives lent respectability to a mining camp and schools and churches were built soon after. She pays particular attention to the additional, and often common, occupations of wives and prostitutes. Both wives and prostitutes ran boardinghouses, cooked and did the laundry of single miners. The task of nursing the sick and injured also fell to them. Women also ran businesses and worked in professions not usually open to them, including running dry goods and grocery stores, post offices and liveries. They also were miners, detectives, and doctors.

Single women tended to quickly marry, and even "fallen women" (prostitutes or women who had otherwise been shamed) were able to do so or otherwise better their lives. Woyski also comments on the leavening role women played in establishing law in mining camps and towns. This participation led to more equality for women and, she believed, laid the groundwork for women's suffrage. Christine Fischer (1978), in the *Southern California Quarterly* article "Women in California in the Early 1850s" describes the circumstances that drew women to California, the conditions in which they found themselves upon arrival, and their adaptation to these conditions. She notes that early arrivers were treated with respect, primarily because of their scarcity and without regard for their employment. As more women joined the men in the West, the social environment came to resemble what they had left in the east. In her book *Women's Voices From The Mother Lode*, Susan G. Butruille (1998) discusses many of the same topics as Woyski. Buttruille focuses on the period leading to the discovery of gold in California and through the 1850s. She deals mainly with the inhabitants of what she called "gold districts." She emphasizes the dual roles women had to play, the first as companion to her husband, and second as a strong-minded able partner in her husband's endeavors. Buttruille notes that some behavior found unacceptable in "civilized society" was acceptable in mining towns and this afforded women a degree of freedom they must have enjoyed.

Archaeologists also began writing about gender issues in the 1980s, and Alexy Simmons' (1989) *Red Light Ladies: Settlement Patterns and Material Culture on the Mining Frontier* was the first comprehensive study of women in the West. Simmons studied the growth and changes in the industry using examples from Jacksonville, Oregon; Silver City, Idaho; Virginia City, Nevada; Helena, Montana; and Cripple Creek, Colorado. Particularly, using documentary records, she mapped the location of these businesses as they related to overall town development. This study importantly linked changing attitudes toward prostitutes to the maturing of the frontier and evolving social and moral attitudes of the country.

In his summary of the mining archaeology of gender, and its nexus with class and ethnicity, Donald Hardesty (1994:129) argues, "Gender is one of the principles that structure the social and cultural organization of human groups and that must be considered in interpreting the documentary and archaeological records of the past." He structures his own analysis of multiple mining community sites throughout the West at the household, community, and regional scales. Assemblages of family households are consistently dominated by alcohol-related artifacts, while the all-male boarding houses contained few, demonstrating the social habits of the two groups, or at least where they did their drinking (Hardesty 1994:138). At the community level, Hardesty explores the neighborhood divisions with regard to brothels and family households that are visible in deposits. Two notable patterns were observed at the regional level, reflecting entire mining districts: first, women lived "in town, with families at outlying ranches, or at toll stations managed by families," while the male-dominated working class occupied satellite communities; second, in regions dominated by company-controlled mines, working class women also made up a sizeable part of satellite towns servicing the mining work force.

Deborah Tibbetts (1997:64) provides a discussion on female markers, noting that men would have used much of the material culture often associated with women in their absence,

and concluding that the best indicators are clothing, adornments, and cosmetics. Penni Carmosino (1998) formulates hypotheses regarding men, women, and children to examine the relationship of family and household structure to Victorian ideology. Both of their case studies demonstrate the presence of women in separate mining community households in the Sierra Nevada, one the placer mining camp of Harrison Diggings and the other the lode mining town of Forbestown. Carmosino specifically draws from archival documents and artifact deposits to demonstrate the presence of women and children within a 1890s household, and to examine what impact that had on the material expression of the family; a middle-class American family influenced by Victorian ideology of the period.

The most comprehensive study of women in mining camps—particularly in saloons and brothels—was conducted by Catherine Holder Spude in her article *Brothels and Saloons: An Archaeology of Gender in the American West* (2005). Seven of her eight artifact collections were from mining towns and camps, and she demonstrates the ability of the archaeological record to distinguish these two enterprises. Like Tibbetts, she argues for classifications of artifacts generally lumped into "personal" categories into female- and male-specific items. Female items include fancy buttons, hairpins, earrings, pendants, makeup and cosmetic containers, corset stays, thimbles, douching paraphernalia, and curling irons. Male-specific items include pocket knives, suspender buttons, watch fobs and chains, collar stays, cuff links, shaving mugs, straight razors, and large belt buckles. Spude's statistical comparison of artifact categories related to gender, alcohol consumption, medicines, tobacco, household items, armaments and other topics by site type includes control assemblages from all-male camps and both temperate and drinking domestic households. Her interpretations provide important discussions on women's lives and, perhaps more significantly, a method for distinguishing saloons and brothels in the archaeological record. Structures with large number of bottles in poorly documented mining camps are commonly labeled as saloons where this occurrence is also typical of brothels. Until an effort is made to "pry gender from the discards of the past," this important story of women's western history will remain untold.

Susan Lawrence (1998) takes a feminist approach in her community studies of gender at Dolly's Creek, a placer gold-mining community in the Australian gold fields occupied during the third quarter of the 19th century. Lawrence found households that included women contained decorative items suitable for a parlor, further substantiating the notion of "maintaining a proper household environment as women's work" (Lawrence 1998:50). The households without evidence of women in the assemblage lacked diversity, and represented "basic goods necessary for subsistence in a short-term diggings camp" (Lawrence 1998:53).

Children are rarely targeted as a topic for mining sites by either historians or archaeologists. While certainly not numerically significant during the Gold Rush, their numbers grew with those of women. During the 1870s at the mining town of Melones, between the rush of the 1850s and the hard rock boom to come,

> …the town assumed as decidedly domestic nature…The seven women listed in the 1870 census contributed twenty-eight children to the community, and the numbers of children appear to have exceeded those of the adult male population until the arrival

> of the mining companies in the late 1890s. Appropriately, a public school appears in the historic documents after 1883 [Costello 1986:26].

The character of a town is affected not only by women but also by the presence of youths and evidence for them should be sought both in documents and in the ground.

Questions

- Is the presence of women or children visible in the archaeological record?
- Were they part of a family household or some other context?
- How did mining households or communities containing women and/or children differ from those without?
- Did women or children mine? Were women or children employed at a mine? In what capacity?
- How are sites where women or children are evident different from those without?
- What activities were women involved in? Did women or children support mining by providing other services?
- Did women or children arrive to a mining site during a later period, and how does this fit into the context of the region?

THEME 5: ECONOMY

This theme explores the economics of mining at various scales, from the household to the world system. National Register Bulletin 42 reflects this emphasis by recognizing issues of "production and consumption of commodities in the mining frontier marketplace" as important topics (Noble and Spude 1997:17). This research theme provides a measure of the rate at which broad cultural trends and technological innovations reached the mines. Historians and historical archaeologists often explore these themes in broad, generalizing terms, comparing archival or archaeological data and observing contradictory or complimentary patterns.

Theodore S. Solomons (1938), in his *California History Nugget* article "'Making Money' in Early California," notes that before the government established a mint in California, private mints made gold coins with their value stamped on their face. These coins were used in place of the gold dust which had become an increasingly impractical method of exchange. The need for a regularized system of currency led to the establishment of the federal mint in San Francisco. In his *California Historical Society Quarterly* article "The Founding of the San Francisco Mining Exchange," Charles A. Fracchia (1969) notes that there are only a few accounts about founding the San Francisco Mining Exchange in spite of the fact that it played a crucial role in the development of Comstock mines and in the growth of San Francisco. Robert A. Weinstein's (1970) article, "Gold Was for the Young," (*California Historical Society Quarterly*) describes the requirements for safe storage and shipment of gold and precious metals, and noted that banks were formed to provide this. One bank that survived to today is Wells Fargo & Co.; Weinstein

uses illustrations and photographs to tell the history of the bank and depict the physical structures it used.

The injection of foreign investment capital in California mining was the subject of Clark C. Spence's (1961) article for *New Mexico Historical Review*, "British Investment and the American Mining Frontier, 1861–1914." Noting that the amount of British investment in California during the Gold Rush had been described as "… a lake of money, bank full and running over" he nonetheless urges a skeptical view of this statement. Although there was a great deal of British investing in California during the Gold Rush, Spence shows that these investments were often not as extensive as they may have seemed. Many investors were non-British (often Americans), and many of the shares remained unsold when investors lost interest. He also demonstrates how British investment in America was part of a larger investment in mining all over the world, and their levels of investment in California were in direct competition with possibilities elsewhere.

Insight into a mine's financing can be gleaned from the physical evidence of specific technologies: well-funded mining sites tend to be on the cutting edge of technologies, while poorly capitalized enterprises often rely on simple inexpensive techniques that have been in use for considerable time. The first 60 stamps of the Royal Mill at Hodson, an operation well-financed with money from abroad, were constructed in 1898 of the newly popular Portland cement (Fuller and Costello 1990b); and the first electric power plants in Calaveras County opened in 1895 near Murphys to serve the Utica Mine in Angels Camp, expanding by 1903 to reach the mines of Sheep Ranch, Hodson, and Carson Hill (Limbaugh and Fuller 2004:149).

Elliot (1995) demonstrated how archaeologists link objects to their sources to study how local mining economies changed as the West developed. Hardesty also examined this issue, specifically showing how artifact source data can contrast sharply with documentary evidence; although he stresses both are important elements of understanding the prevailing interaction spheres (Hardesty 1988:3). The archival documents shed light on Nevada's reliance on a Western-dominated distribution network, particularly for its heavy machinery, while the archaeological imprint demonstrated the mining state's dependence on Eastern manufactures, especially for its bottles and cans.

Historian Robert A. Burchell's (1989) "The Faded Dream: Inequality in Northern California in the 1860s and 1870s," in the U.K.-based *Journal of American Studies* notes that while there was a substantial body of scholarship on the instant wealth of the Gold Rush, there was little on the fluid nature of class. Burchell's article illustrates that inequality was as much the norm in California as it was elsewhere in the United States. Using data for distribution of property, wealth and income, he shows there was substantial inequality in California.

Spatial organization of households may also convey status. At large mining sites, the owners and management were located higher on the hillsides, and farther from the mills, than the workers. Richard Francaviglia (1991:99–105) discusses the social geography of mining settlements where residence locations depend on ethnic as well as economic status. Hardesty describes the stratification of homes in Virginia City:

> On the upper streets of the town were the large and luxurious houses of mine and mill owners and wealthy merchants. The commercial and governmental districts were on B and C streets just below, along with "working class" residences. Below C Street in descending social and geographical order were the "red light" district and Chinatown. And at the very bottom scattered around the mill tailings were the Native American residences [1988:14].

This predictable distribution of residences occurs in mining communities of all sizes. It was noted at the townsite of Melones (Costello 1986:47–48) and at the small settlement around the Edel Consolidated Quartz Mining Claim (Walker et al. 2006). At this latter site, plat maps depicted a supervisor's residence across the street and higher on the hill than a workers' boardinghouse. Fieldwork at these locations discovered additional dwellings at these locations that followed the same pattern. Francaviglia (1991:107–108) also notes that mining camp residents lowest on the social ladder often were not employed in mining but in support industries. Archaeologists can take advantage of this stratified residential pattern to look for both recorded and unrecorded minority settlements in marginal areas of mining sites. They can then compare the household assemblages from these segregated households to reveal additional aspects of class and/or ethnicity.

Business and mining is relatively little discussed by historians; most of the emphasis has been on finance or the role of market trading with miners. Randall E. Rohe, a historical geographer, has written extensively on the mining industry of the West. His article, "Feeding the Mines" The Development of Supply Centers for the Goldfields" (Rohe 1985), in *Annals of Wyoming*, shows that miners devoted as little time as possible to gathering and preparing the food necessary to sustain them. Local traders who met their needs were, in turn, restocked through quickly established supply routes.

Archaeologists use a variety of material indicators to infer class. Schmitt and Zeirer (1993) contrast two classes of artifacts—ceramics and faunal material—to examine the socioeconomic status of households in the historic mining town of Grantsville, Nevada. The community grew from a small mining camp in 1877 into an averaged-sized town, but when ore output declined by the 1890s, so did the town. The value of ceramic assemblages and simple quantity and variety of faunal bone were found to accurately convey the diversity of household means. Meat quality—typically relied on to identify class—reflected more about market access in mining contexts. "Fresh meat purchases were dictated by what the butcher had on hand," the principal customers being large volume consumers like boarding houses or restaurants. The "inhabitants of small, isolated communities such as Grantsville were restricted to products offered by local suppliers, and households could not as readily or consistently express their status through high-quality cuts."

The period after the Gold Rush has been discussed in a variety of works. Particularly helpful is an article by Lary M. Dilsaver (1985) entitled "After the Gold Rush" in *Geographical Review*. Dilsaver reports that most scholarship on the Gold Rush focused on the transitory nature of settlement, implying movement to other sites left behind abandoned camps, mines, and ghost towns. He demonstrates that primary economic activity began to shift from mining to agriculture and other functions during the Gold Rush and continued through the 60 years that

followed. This shift was marked by changes in patterns of settlement, the replacement of mining camps with settlements devoted to other industry, and the concentration of settlement in fewer areas. Dilsaver shows that while mining towns in placer areas declined, new towns less directly related to mining emerged near railroad lines. Most of this shift occurred between 1855 and 1914. Dilsaver's article was based on his 1982 Louisiana State University dissertation, *From Boom to Bust: Post Gold Rush Patterns of Adjustment in a California Mining Region (Volumes I and II)*. The dissertation examines the change that California underwent from a nearly exclusively gold-mining economy to a more diverse structure, especially with the decline in mining. Miners that left California were replaced by other settlers, and the economy, sparked by the railroad, shifted to lumber, agriculture and tourism.

Mining has filled a variety of economic niches as a primary means across income levels: self-employed members of a joint company, wage-workers at a mine, the mine superintendent, local and distant investors. It also supplied supplemental income in various survival strategies. Tordoff's (2005:83) Logtown report documented residents who "combined mining with agriculture or ranching…these are the people who resided the longest."

Patricia Nelson Limerick's (1998) *California History* article "The Gold Rush and the Shaping of the American West" focuses on how the Gold Rush shaped the American West. She states miners' interaction with, and removal of, Native Americans was an important factor in shaping the West. Limerick also found that the truly American trait of claiming ownership of the land with complete disregard for those who had already settled the area (Mexicans) or other groups (Chinese) who arrived at the same time as white Americans was another important factor. Others included areas that were heavily populated (the precursors for urban centers), poor sanitation, the heavy reliance on food from outside sources (such as farmers), and the paradox of needing farmers yet destroying the farmers' farms, and squabbles over water rights, a battle that continues today. Also noted were the nostalgia of women in mining towns and the experiences of miners, felt at different times, but with the same intensity. She ends the article with a comment on the continuity of mining today and asks if this stems from a kinship with California's mining past or if it constitutes an association formed by choice.

Hardesty (1986, 1990) argues that the physical record of mining must be viewed in the context of world system phenomena. The study of globalization can focus on linkages or networks between various components, mining systems being one (Wolf 1982). Self-sufficiency, a central component of the Frontier Model (Greenwood 1982:11), is relevant to the analysis of gold mining communities. Early placer miners, for example, have been characterized as young single men imbued with strong laissez faire individualism (Hardesty 1988:103), who were generally egalitarian and anti-corporate (Cornford 1999:87; Jung 1999:53; Zerbe and Anderson 2001:122). The level of self-sufficiency in a mining community is a common theme; Jenson (1980) and Tordoff (2005) synthesize archaeological data with the Self-sufficiency model.

Greenwood (1982:246) argues that the gold-mining frontier is not explained well using the Self-sufficiency model; instead she found mining sites "not economically independent or self-sufficient; they were closely connected with the outside world, and they focused on rapid exploitation of the environment rather than on permanent development." In contrast to self-sufficiency is the measure of dependency of a frontier on the homeland. Shoup (1983a:7)

highlights key aspects of the Dependency model, including reliance for material culture, reproduction of labor force, social values, resource ownership, decisions, and capital. Tordoff (2005:37) has recently supported this characterization for mining sites, noting that "the focus is on dominating the environment in order to extract whatever wealth is available; often most of that wealth is exported to absentee owners."

Winthrop et al. (1987) explore Self-sufficient, Dependency, and Metropolitan models developed by Shoup (1983b) and Robbins' (1986) "plundered province" thesis in their study of Depression-era mining sites in Northern California. They recognize a pattern to the region's industrial history associated with a shift in investment from urban entrepreneurs to the federal government prior to World War II (Winthrop et al. 1987:50); a pattern that can be examined throughout the West. They term one aspect of the pattern "self-sufficient poverty;" typically characterized by small, self-sufficient farmsteads, but during the Depression also including large numbers of single men who relied on gold mining to get by. Hardesty (1998) incorporates this concept in his exploration of power in mining communities of the West. In this context mining is portrayed as supplemental income balanced with other seasonal occupations such as wage labor or ranching; consumption was dominated by hunting, gardening, and barter, with gold providing a small cash income for manufactured goods. Miners were seen as resilient during the Depression since they depended little on the national economy.

Questions

- Who invested in the mine (the miners, joint-stock company, outside capital)?
- Was the mining venture heavily capitalized? Is there evidence of expensive and/or imported materials and/or technology?
- Are a variety of socio-economic classes evident at the site? Is class segregation evident? How does the material culture of different mining classes compare?
- What role did the mine (or mines) play in the region's growth and economic development?
- What were the labor patterns in the region? Was there competition for labor or a strong labor pool, and how did these dynamics change through time?
- How does the socio-economic profile of households and the site change through time?
- What businesses were present, and in what phase did they develop?
- Where did the miners get their food and other goods and services (supply networks, local vendors, self-sufficient gardens and hunting/fishing, company store)? How did this change through time?
- What types of access to markets was available during different periods?
- What types of changes are evident (mining machinery, goods) following the completion of the transcontinental railroad? At what pace did industrial infrastructure develop?

- Did miners invest much time preparing food at home, or did they eat away from their residences? Did they reside in rooming houses and eat at boarding houses?
- Was mining only a facet of a more complex survival strategy, in which other pursuits such as farming or wage labor also played roles?
- How did the role of mining change with time for individuals, households, communities, or regions?

THEME 6: POLICY

This theme explores the nature of governmental development and regulation. Company policy may also be relevant. Particularly in California, this has often been examined at the mining district level, although federal and State governments exerted control over time. Included here are issues relating to mining's environmental effects.

Historians' articles addressing issues of law, government, and the development of order in California, particularly during the Gold Rush, tend to focus on three major topics: crime and criminals, the development of mining law and water rights systems, and the relationship of the State government to federal government. Perhaps unsurprisingly, archaeologists have contributed little to this theme.

Violence and crime in the mines has been the topic of several articles. Clare V. McKanna, Jr.'s (2004) *Pacific Historical Review* article "Enclaves of Violence in Nineteenth-Century California" described the ongoing debate about whether or not California Gold Rush towns were actually violent. McKanna's article offers a system of measuring violence to assist historians in deciding if Gold Rush towns actually were violent or not. The key element in his system is determining the existence of a sense of community and the degree it was felt by townspeople. He believes that towns that had a large population of permanent settlers, primarily families, had a greater sense of community and were therefore less violent. In contrast, towns with a predominately single male population that was transient and ethnically diverse had high levels of violence. Of course, this system is equally useful for archaeologists measuring violence since the contrasting communities would produce distinguishable signatures. McKanna asserts the difference was caused by a lack of local systems of control, or local government. Boomtowns, mining camps and other such temporary settlements often lacked such systems. Added to this were rapid population growth and a culture of alcohol and gun use, creating a climate of violence. He concludes that while much of the American West was relatively non-violent, some parts of it were extremely violent.

In a similar vein, Roger D. McGrath's (2003) "A Violent Birth: Disorder, Crime, and Law Enforcement, 1849–1890" in *California History* adds to the historic record with an account of violence in Gold Rush California. The author gives a lively account of two bands of outlaws that terrorized the West: Joaquin Murieta and his band, and the so-called "Hounds" of San Francisco. He also describes the vigilante violence that was commonplace in the west. McGrath includes accounts of individual outlaws, the often limited action taken by formal law

enforcement institutions, and the formation of vigilante committees to uphold the law. He believes that the root of this violence was a code of honor that made men duty bound to fight when insulted or wronged. Martin Ridge's (1999) *Montana* essay "Disorder, Crime and Punishment in the California Gold Rush" focuses on lawlessness and violence as well. He reports that while many believed California mining towns were lawless violent places, they were neither, as long as person and property were respected. His article is primarily an account of the lawlessness in California, with several locations cited as examples, contrasted with the lawfulness of California, using the same locations as examples. Common throughout all is the idea that lawlessness was ignored when one was only bringing injury upon him/herself. Should one injure an innocent party, either physically or financially, punishment ensued.

Some historians have assumed there was no pressure to establish government in Gold Rush California as national attention at the time was focused elsewhere. Other historians have disagreed and shown that miners and settlers were interested in establishing a government from the start of settlement. William A. Bullough (1991), in the *California History* article "Entrepreneurs and Urbanism on the California Mining Frontier: Frederick Walter and Weaverville, 1852–1868," agrees with the latter view and offers Weaverville in Trinity County as an example. He recounts the rise of Frederick Walter from a child in Trinity County to the head of a thriving business and a civic leader. Bullough sets this story in the framework of the "settling down" of Weaverville and its transition to a more civilized town.

Richard O. Zerbe Jr. and C. Leigh Anderson (2001) take a wide-ranging view of the development of government institutions and cultural norms in their *Journal of Economic History* article, "Culture and Fairness in the Development of Institutions in the California Gold Fields." They note, "earlier accounts of the creation of property rights in the California gold fields ignored culture and are incomplete. We argue that culture matters in solving collective-action problems. Such problems in the California gold fields were solved though reliance on cultural focal points." Zerbe and Anderson add, "focal points included individualism, equality, respect for property, and rewards commensurate to work. Cultural concepts of fairness served to create norms and institutions that miners were willing to defend, which included majority rule, election of officials, trial by jury, allocation of a first-come, first-served basis and rules for working claims" (Zerbe and Anderson 2001:114).

In a somewhat more focused article, western historian Donald J. Pisani (1991) describes how water law concepts adopted in western states were influenced by the mining experience. His article "The Origins of Western Water Law: Case Studies from Two California Mining Districts" in *California History* points out that western water law is commonly examined from the perspective of state legislation. He sought to examine water law from the experience of miners, and examined the origins of water law from the perspective of miners, their views, values, and ideals. Pisani suggests the doctrine of "prior appropriation," the policy that those with the earlier claims to the water source have priority of use, emerged slowly and in response to the rise of private corporations and new mining techniques. Prior appropriation meshed well with the American ideal of limited government and had the added benefit of requiring no bureaucracy to manage it.

Tordoff and Seldner (1987:13) hit on this topic inadvertently in their archeological investigations of mining sites in the Cottonwood Creek drainage, southwest of Redding, when they asked "how were the miners organized, and what was their source of capital? What types of claims to water and mining land were taken? To non-mining land?" However, they found the archaeological record poorly suited to address these questions.

Federal–State relations were the subject of Robert J. Chandler's (2003) "An Uncertain Influence: The Role of the Federal Government in California, 1846–1880," in *California History*. Chandler reported that the popular myth of the origins of California is one based on rugged individualism. He found, however, that California was heavily dependent on federal aid during the period he studied, demonstrating that the federal government played a large role in the establishment of a California government. From the beginning of U.S. control of California, the federal government provided leadership in the form of military officers, a daily mail service, and crucial aid in building the transcontinental railroad. The federal government also promoted conservation and civil rights in California. The article covers policy setting, federal patronage, the establishment of federal agencies in California, and the prevention of a secessionist movement in California during the Civil War.

The effects of mining on the California environment—particularly the relationship between destructive flooding, agriculture, and hydraulic mining—have been widely discussed in the historic literature. Among the first to address this issue was pioneering public historian and University of California, Santa Barbara, history professor Robert L. Kelley. His seminal book on the subject, *Gold Versus Grain*, was written in 1959. In 1956 he wrote "The Mining Debris Controversy in the Sacramento Valley," for the *Pacific Historical Review*. Kelley reported that as farmers began to outnumber miners and ranchers, legal controversies emerged focusing on the deleterious effects of hydraulic mining debris on agricultural lands downstream of the mines. His article is a commentary on the struggle, in court, between the miners and the farmers of the northern Sierra and Sacramento Valley. Kelley blamed the annual flooding of the valley on tailings from hydraulic mines that washed downriver: rainfall pushed the debris and mud down from the mines and caused the rivers and streams to flood, ruining thousands of acres of once rich farmland. In response local farmers formed the Anti-Debris Association of the Sacramento Valley to fight for protection. The miners organized the Hydraulic Miners Association to fight back. The controversy led to a long and expensive legal battle that resulted, for all practical purposes, in the end of hydraulic mining by 1884. A somewhat different view was offered four years later by Kenneth Thompson (1960), in "Historic Flooding in the Sacramento Valley," published in *Pacific Historical Review*. Thompson believed historians misunderstood the clash between hydraulic miners and farmers in the late-19th century, arguing that the extent that hydraulic mining caused flooding in the Sacramento Valley has been poorly understood. In the article he describes pre-Gold Rush flooding in the Central Valley, and provides first-hand accounts of flooding from inhabitants and visitors in the area as well as an extensive analysis of geography and weather patterns. Thompson, however, was hesitant to relieve miners of the burden of flooding the valley, and acknowledged they were part of the problem.

Other writers have taken a more global view. Waverly B. Lowell's (1989) article, "Where Have All the Flowers Gone? Early Environmental Litigation" in *Prologue* asks: "Is a civilization worthwhile if its material needs destroy the natural world?" Lowell provides examples of early environmental litigation and a brief legal history of early environmental law in California, focusing primarily on cases that dealt with water pollution from mining operations. Another wider-ranging examination of environmental problems caused by mining can be found in Martin D. Mitchell's (1994) *Geographical Review* essay "Land and Water Policies in the Sacramento-San Joaquin Delta," which addresses the questions of how and why water policies in the Sacramento-San Joaquin area emerged. Mitchell examined the role of wetlands, policy conflicts, and the mining debris controversy: the use of waterways to convey mining debris and its effect on agriculture and navigation. He identifies the federal Caminetti Act of 1893 as crucial legislation that helped establish later state-federal cooperation in flood control and other areas.

Similarly broad is David Beesley's (1996) "The Opening of the Sierra Nevada and the Beginnings of Conservation, 1821–1900," in *California History*. Today, environmentalists believe that the main cause of environmental damage to the Sierra Nevada is civilization's constant encroachment. Beesley states that the need for environmental protection and preservation began when gold was discovered, a historical element lacking in many modern environmental studies. He notes three phases that led to development of a preservation movement in the Sierra. In the first phase starting in the 1820s, the mountain range was seen as a dangerous obstacle to cross as quickly as possible. As a result, there was little or no lasting damage done to the region. In the second, beginning in 1848, the mountains were seen as a source of valuable resources. Finally, in the third phase, after the early 1900s, preservationists looked upon the ravages of mining, ranching and logging with concern. These activities damaged the mountain lands and threatened the valley below. This threat led to pressure to protect and preserve the Sierra Nevada, and in the decades Beesely studied, the federal and state governments acted to manage and protect the area. Beesely describes the U.S. Forest Service, with its management plan, both created in 1871, as one of the first steps, followed by the Forest Reserve Act of 1891, which replaced the State Board of Forestry created in 1885. Finally, the National Park Service was created in 1916 to manage and patrol California national parks.

Raymond F. Dasmann (1998), in "Environmental Changes before and after the Gold Rush," written for *California History*, notes that the early environmental damage of California was usually blamed on miners. His study found that there were other factors contributing to this damage—fur trappers, cattle ranchers, and fishermen came to California along with, and sometimes before, the miners. These activities did their share of damage. According to Dasmann, much of the damage was already done when gold was discovered. The "cattle rush," "fur rush," and introduction of foreign grasses began the work of depleting the resources of California, which the Gold Rush later sped along. Similarly wide-ranging is John W. Caughey's (1992) *California Historical Quarterly* piece "The Californian and His Environment," which broadly addresses the relationship of man to the environment in California, beginning with pre-history and following through to the early 1970s.

Questions

- What type of social order is evident at the site? Does the site exhibit a sense of organized community (e.g., a large population of permanent settlers, primarily families)? Or, was it predominantly an ethnically diverse transient male population? Was one type of community more violent than the other? Does one type have a larger density of munitions than the other?
- Was anything done at the local level to prevent crime? How do sites with variable crime rates compare archaeologically?
- Were social boundaries established or enforced based on ethnicity, class, or other social or political factors?
- Is the site within a known mining district? Are the mining codes for the district known? How do sites within and outside of formal mining districts differ?
- What was the size of the mining claim? Can the size of the claim be determined from either field or archival sources (e.g., boundary markers, extent of mine activity, legal descriptions)? How does it compare to mining code standards?
- How many miners worked the mine and how were they organized? Is there evidence for social inequality?
- How did the organization (variety, distribution, density) of miners change through time? Did increasing State and federal legislation (e.g., general mining law) result in any change?
- Did company policy result in changes of technology or social behavior at the site?

Chapter 5. Implementation Plan for Site Identification and Evaluation

The preceding historic context and review of scholarly research themes are intentionally broad in scope. They provide the essential foundation that is impractical for most archaeological investigations to develop. This chapter offers guidance on how to implement the foregoing in order to identify and record mining sites, and evaluate a particular property's research potential under NRHP criterion D. The reader should keep in mind, however, that mining sites may also be determined significant under other NRHP criteria.

A five-step process for identifying an archaeological property's eligibility under Criterion D was presented in Chapter 1 (Little and Siebert 2000:14). For mining sites, this process is divided into two phases:

Phase 1: Identification and Recording of Mining Sites

1. Determine the property's structure, content, and the classes of data it may contain.
2. Identify the appropriate historic context by which to evaluate the property.

Phase 2: Evaluation of Mining Sites under Criterion D

3. Identify important research themes and questions that might be addressed by the site data.
4. Considering the property's integrity, structure, and content, assess whether the data it contains are of sufficient quality to address these important research issues.
5. Identify the important information that the property is likely to contain.

The numbered steps within each phase generally occur as part of an integrated process, and not necessarily sequentially. Particular aspects of these steps are discussed below, followed by a step-by-step approach that illustrates their application.

This implementation plan is focused on the remains of the mining activities themselves. While this research design addresses the importance of domestic deposits for advancing the research themes discussed herein, it does not detail their evaluation. For assistance in determining the data potential of these domestic resources the researcher should consult the Town Sites and Work Camps research designs (HARD Town Sites Team 2007; HARD Work Camps Team 2007).

PHASE 1: IDENTIFICATION AND RECORDING OF MINING SITES

Step 1. Determine the property's structure, content, and classes of data.

Step 2. Identify the appropriate historic context.

The initial identification and assessment of a mining site is dependent on accurately identifying the remains present on the ground, associating these with the correct historic period, and identifying the mining process represented.

Remains of mining technologies are generally visible on the surface and excavation is rarely necessary to identify and record them. Exceptions are found in locally-made features such as arrastras that may warrant exploration. It is typical of mining sites that evidence of earlier operations will be covered over or destroyed by later workings. These buried remains, however, are not recommended as subjects of excavations as the information recovered rarely justifies the efforts expended.

The historic context presented in Chapter II provides a basic foundation for the identification of mining sites statewide. Each site, however, will require site-specific documentary research. Prior to archaeological survey and recording of a site, background documentary research is needed to identify the general mining practices common in the region for different time periods. Historic maps and other base-line sources should be consulted prior to fieldwork so that archaeologists can anticipate the types of resources they will find. For simple mining sites, this is often all the research that will be needed. It should be noted that at this point, potential eligibility under other NRHP criteria may be revealed.

The researcher must learn which activities identified in Chapter III (placer mining, beneficiation, habitation, etc.) were carried out at the site. Research should focus on addressing basic questions such as who, what, when, where, and how. One of the goals of historical research is to help establish the property's period of significance, defined in National Register Bulletin 36 as "the time range during which the property was occupied or used and for which the property is likely to yield important information" (Little and Siebert 2000:34). Defining the period of significance gives temporal focus to the context in which the site will be evaluated. Common sources of historical information are listed in each site type discussion; however, these lists are not to be considered exhaustive nor are they to be used as simple check lists.

To evaluate a more complex industrial mining site or a site with associated domestic features, however, site-specific archival research must be conducted. Primary documents, secondary sources, and oral accounts may all contribute to providing details of site history. The plan for historical research should specify cost-effective sources of the information. A complete title search, for example, may not be necessary if adequate data can be obtained more readily from maps. Secondary sources are often most useful for general background information while primary sources speak to specific times and places.

It should also be noted that due to the prevalence of mining systems, complex sites are often recorded as districts. As Noble and Spude (1997:Ch.V,p.1) observed:

> Most potentially eligible mining properties do not consist only of a single resource, but rather will include a discrete historical area containing a grouping of functionally related resources that all played a part in the extraction, refinement, and production of minerals.

Whether mining resources are recorded as a series of features within a site or a number of sites within a district depends on the complexity and size of the enterprise. Discontiguous districts may also be appropriate where elements of a site are spatially separated and discrete, and where the space between them does not contribute to the significance of the district (Noble and Spude 1997:Ch.V,p.1). Sites may be contributing elements of an important district, where individually they might not meet eligibility criteria.

PHASE 2: EVALUATION OF MINING SITES UNDER CRITERION D

Step 3. Identify important research themes and questions.

Step 4. Considering the property's integrity, structure, and content, assess whether the data it contains are of sufficient quality to address these important research issues.

Step 5. Identify the important information that the property is likely to contain.

At this point the researcher has identified the property types that exist, or are likely to exist, on the site through a combination of archaeological fieldwork and historical research, and has related these to both statewide (this document) and local historical contexts. The next step is to determine appropriate research themes and questions that the properties may be able to address. Chapter IV contains reviews of scholarly research themes in history and archaeology, concluding with a list of some of the important research questions. These lists—which are not exhaustive—may be used to derive other research themes and questions relevant to sites under evaluation. Researchers are encouraged to use these questions as sparks for the imagination and not as fixed canon.

Key to identification of appropriate themes is an appreciation for the data that is available from each site to answer these questions. The data comes from both the archaeological and archival/documentary records and is the base on which all interpretations are made. Simple sites with limited data—such as an isolated prospect shaft with a waste rock pile—will have little to contribute to complex themes. Large industrial sites, with extant foundations and surface workings, along with corresponding mining records, photographs, and maps, have the potential to provide much more information and address more complex themes.

This is arguably the trickiest part of the evaluation process, for it requires the researcher to assess the relationship between a site's physical characteristics and a more abstract dimension—its contribution to substantive research. The NRHP uses the concept of integrity to bridge this conceptual divide.

Integrity

National Register Bulletin 15 defines integrity as the "ability of a property to convey its significance." A site must have integrity to be eligible for listing on the NRHP. The NRHP Criteria for Evaluation recognize seven aspects of integrity—location, design, setting, materials, workmanship, feeling, and association—and a resource must maintain several of these aspects to maintain integrity. Every evaluation of NRHP eligibility must discuss the aspects of integrity that are relevant to the important qualities of the site being assessed.

Archaeological sites are usually evaluated under Criterion D. Here, a mining property's significance depends on its ability to provide important data, measured by its potential to contribute toward research themes in a significant way. In general, archaeological properties should retain integrity of location, design, materials, and association to be important under Criterion D. There is usually no need to address setting and feeling as these characteristics rarely affect a site's information value; however, these aspects are important for assessment of integrity under other criteria. It is also common for a site such as a small prospect to have excellent integrity and yet lack sufficient information to satisfy Criterion D and therefore be evaluated as not eligible. National Register Bulletins 15 and 36 as well as the book by Hardesty and Little (2000) provide detailed, practical guidance on how each of these aspects of integrity should be applied. National Register Bulletin 42 also specifically addresses integrity of mining sites. The following discussion addresses aspects of integrity that generally apply to mining sites:

Location

While the location of a mine cannot be altered, the equipment used to mine and process the ore was frequently relocated as ores were depleted. The integrity of historic mining equipment relocated to another contemporary historic mine would not be diminished even though the equipment had been moved from its original location of operation. If the same equipment was relocated to a modern mine (less than 50 years old), its integrity would be diminished.

Design

The second aspect of integrity is design, which refers to the layout of the site. As discussed before, new developments in mining and milling technology introduced new equipment to mining sites as well as changing the methods that mines were worked. Improved methods often led to revisiting old sites where tailings could be processed a second time. Just as the surface plant might change, so too could the size and scope of the excavations. Because of the evolving nature of mining operations, a mine does not have to maintain its original site plan to have integrity. The changes should demonstrate the mine's evolution, and should have taken place at least 50 years ago. Changes within the last 50 years, or the modern period, would reduce the integrity.

Another aspect of design is the completeness of the site. Does the site have all of the surface plant or stages of ore processing? Few mines possess a complete surface plant, but if there are enough artifacts remaining to understand the process of reducing ore to the target mineral, then the mine could retain a measure of this aspect of integrity. Similarly, if a placer

mine conveys the actual process that was used to mine, whether a single event or many over time, it retains integrity of design. A common mining site might consist of a shaft and a collapsed adit, scattered artifacts, and a large waste rock pile. Even if archival information indicated that the shaft ran deep and that considerable time was spent developing the mine, it can be argued that the remaining objects do not convey a sense of the mine's operation. Lacking structure remains or artifacts that provide evidence of the mine's operation, it does not retain integrity of design.

Setting

Setting, the third aspect of integrity, reflects both the grounds of the mine and its surrounding environment. Mines in the desert areas of the state often have been relatively untouched, and their surrounding environment has been left largely undeveloped. Mines in the Sierra foothills, or in Shasta and Siskiyou counties, have more frequently been surrounded by modern buildings and structures that may adversely affect their setting. This aspect of integrity needs to be carefully evaluated in assessing a mining site's significance under criteria other than D.

Materials

Integrity of materials requires that the resource be constructed with materials that date to any period of significance. Research potential depends on materials having not been altered beyond interpretability.

Workmanship

Workmanship pertains to the physical evidence of the crafts of a particular culture or people during any given time period in history. It would apply to a mining site where mining methods or construction techniques employed by various culture groups contribute to the site's significance.

Feeling

Regarding the aspect of "feeling," Bulletin 42 states,

> As abandoned industrial properties are generally located in isolated areas, the sites of historic mining activity often evoke a strong sense of feeling when viewed by contemporary observers … The feeling of a deserted historic mine can help reflect the character of the boom and bust cycles of mining regions. The loss of this feeling of isolation and abandonment due to encroaching modern development can diminish the integrity of a mining property [Noble and Spude 1997:21].

Generally speaking, feeling has little bearing on an archaeological property's research potential.

Association

The final aspect of integrity is that of association, which as Bulletin 42 notes, "will exist in cases where mine structures, machinery, and other visible features remain to convey a strong sense of connectedness between mining properties and a contemporary observer's ability to discern the historical activity which occurred at the location" (Noble and Spude 1997:21). A

mining resource which lacks buildings or has extensively altered buildings, but does feature other elements such as building foundations, shaft, headframes, tramways, tailings, trash dumps, cemeteries, privies, equipment, and other artifacts might be considered eligible. On the other hand, a site could retain the buildings and not have enough evidence of the mining operation to illustrate a working mine. Such a mine would not have integrity of association because it is not the state of the buildings that holds integrity but the "degree to which the overall mining system remains intact and visible."

Archaeologists also frequently use the concept of association to refer to the degree to which the occupants – or labor force – of the site is known. A good historical "association" enhances the potential significance of the site's data potential. James Deetz (1996:128) used the concept of archaeological "focus" to address integrity and assess the research potential of archaeological sites. By focus, Deetz refers to the level of clarity with which remains at a site can be determined to represent a particular historical phenomenon such as an activity or building remnant. Remains that represent a number of activities or consist of components that cannot be separated from one another are said to lack focus. A site that has poor focus effectively lacks integrity.

Significance Evaluations

Criterion D: Research Potential

At this point the history of the mining site has been established, its data sources identified, integrity evaluated, and applicable research themes and questions noted. The formal evaluation under Criterion D makes clear what important information the property is likely to contain that can address one or more questions related to research themes. Two conclusions are possible:

1. The site may be deemed not significant, because it lacks integrity; or because it has no important data to be recovered.
2. The site may be deemed significant for its potential to contain important information.

For most simple and smaller industrial mining sites, the appropriate documentary research and site recording necessary to identify and record the site "exhausts the research potential" of the resource. This phrase acknowledges that there is useful historic information inherent in knowing that this mining resource was present and active at a specific time using specific processes. The important point here is that once this is known, there is no more important information to be obtained from studying the site further. For many simple mining sites, this threshold may be reached with basic documentary research and a careful initial recording of the site. For more complex sites, more detailed documentary research and field studies may be necessary to recover important site information.

Mining sites with domestic deposits require an additional level of analysis. Many of the research themes and questions presented in Chapter IV focus on the site's residents, and information on these people may be found in their household refuse. The association of the site with specific population groups (ethnicity, gender, social class) may be determined by an analysis of these remains. Particularly for sites that are poorly documented, the domestic deposits may be the primary source of this information. Also, as mining technologies are

generally not easily datable, data on when poorly documented sites were active may come solely from the refuse of its inhabitants. The integrity/value of these domestic components will need to be evaluated in conjunction with Work Camps and/or Town Sites research designs, depending on the nature of the domestic component (HARD Town Sites Team 2007; HARD Work Camps Team 2007). Similarly, these companion volumes present methods for recovering and interpreting significant data.

Other Criteria

As noted above, mining properties may be determined eligible under other National Register criteria, and these should be kept in mind when studying and evaluating a property.

Criterion A. Criterion A is associated with events that have made a significant contribution to the broad patterns of history. This is the criterion most commonly applied to mining sites. Fifteen themes are suggested in Bulletin 42, any of which may apply to mining sites. Particularly appropriate is the theme of engineering, especially – but not exclusively—for late 19th and early 20th century sites. The bulletin states,

> After 1890, many mining complexes featured components designed by mining engineers. This would include water and transportation systems built to serve mining operations. Noteworthy examples of mining engineering would fall under this area of significance. The ascendance of the mining engineer over the skilled craftsperson was a gradual process. Many mining properties can demonstrate the nature of the change and provide evidence of the intermediate steps in the process of change [Noble and Spude 1997:15].

Criterion B. Criterion B is associated with the lives of persons significant in our past. A mining property would not only have to be directly associated with an important historical person to meet Criterion B, but also be a resource that best exemplifies his/her significance. So, for example, although George Hearst, a famous mining engineer and 19th-century tycoon, may have owned a particular mine, research would need to indicate that it was the very mine that earned Hearst his fame or fortune, or represented a turning point in his career. In general, a mine would be highly unlikely to meet Criterion B.

Criterion C. Criterion C embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master, possess high artistic values, or represents a significant and distinguishable entity whose components may lack individual distinction. Those mining properties found eligible under Criterion C are often assessed under the categories of architecture and engineering.

Architecture. Mining complexes occasionally contain cabins, storehouses, and workshops, as well as other, more mining-specific structures as mills, hoists, and processing sites. Such mining structures are often in ruins. Architecture found in these complexes can reflect common building trends or demonstrate innovative use of materials. While the vestiges of surface plants on mining sites may yield information regarding the engineering and working aspects of mining, they would need to represent the work of master architects or builders, or have high artistic value.

Engineering. The methods and technology of mining, like most technical industries, continues to evolve. Mining properties can illustrate these changes through the remnants of machinery and structures. Such structures as the head frame, tower and wire rope for an aerial tramway, mill foundation and other equipment provide an understanding of how a mine operated during the period of its activity, and can give the visitor a strong sense of time and place. Other mine sites may contain equipment. Generally there are few mining properties that have enough remaining features to fulfill Criterion C under the theme of engineering, largely because the majority of sites either had the equipment removed after operations ceased or the remaining equipment was scavenged for scrap during the First or Second World Wars. The removal of equipment for reuse elsewhere or for scrap value was a common practice that raises the value of what little does remain at mining sites. Sites that retain equipment related to mining, or for mills, processing or moving ore provide information regarding the operation of the mine and processing methods.

Sites may also be determined eligible under Criterion C for engineering features that are entirely manifested on the landscape, devoid of any machinery or structures, exampled by the Natomas Ground Sluice Diggings (Lindstrőm 1988), the acres of dredge piles at Prairie City (Lindstrőm 1989; Tordoff 2004), and the Malakoff mine's cliffs and tailings piles produced by large-scale hydraulic mining near North Bloomfield (Felton et al. 1979; Lindstrőm 1990).

STEPS FOR ASSESSING THE RESEARCH POTENTIAL OF MINING SITES

The following outline presents the steps used to assess the research potential of mining sites (Criterion D). Sites are categorized by complexity:

- Simple Mining Sites
- Simple Mining Sites with Domestic Deposits
- Industrial Mining Sites
- Industrial Mining Sites with Domestic Deposits

The steps for each category of site include:

1. procedures for identifying and recording;
2. identification of data required for significance (data requirements); and
3. categories for assessment and evaluation of significance.

SIMPLE MINING SITE

These sites display evidence of simple mining technologies. They contain no domestic remains and no evidence of Industrial Mining. Particularly excluded from evaluation are those Simple Mining sites exempt by Exhibit 1.1, Attachment 4 of the Caltrans *Environmental Handbook, Volume 2* (Caltrans 2004). These exempt sites are not, however, excluded from recordation and "may be documented, if documentation is warranted, at a level commensurate

with the nature of the property (e.g. Primary Record form, Location Map, Memo to File, or GIS cultural database)" (ibid).

- isolated mining prospect pits,
- placer mining features with no associated structural remains or archaeological [artifact] deposits

Examples of such simple mining sites abound in California's desert regions and are common in the Mother Lode. Among the most typical mining site is a simple adit and tailing/ waste rock pile, or a few placer tailing piles in a ravine, with a minor (or absent) artifact/debris scatter. Many of these sites were never recorded as claims or developed in any substantive fashion.

Procedures for Identifying and Recording Simple Mining Sites

1. Conduct Basic Documentary Research
    - Review county mining claims and map files
    - Review county histories
    - Review state mining reports for the area under study
    - Review GLO maps and MTPs
    - Review applicable secondary materials

Such materials are commonly and readily available at the BLM, county libraries and historical societies, and in county government records.

2. Conduct Basic Archaeological Recording
    - Construct a map of mining remains, showing all features
    - Write a physical description of the mining remains
    - Take overview and feature photographs
    - Complete at least a DPR 523 Primary Record and file with map at Information Center; an Archaeological Site Record is always beneficial and may be necessary for more complex sites
3. Identify History of the Site
    This involves reconstruction of mining site processes using a combination of documentary and archaeological data and addressing appropriate Themes identified above in Chapter IV.

Data Required for Significance of Simple Mining Sites

Basic Documentary Data on the site is usually sufficient when it provides information necessary to address archaeological research questions. This information can be derived from some of the following sources:

- Government Land Office (GLO) Maps
- County maps / mining claims files and maps
- reports from the State Bureau of Mines, such as those by the State Mineralogist.
- Bureau of Land Management Master Title Plats (MTP)
- County histories

Secondary material Basic Archaeological Data is sufficient when:

- The site retains sufficient integrity to demonstrate the techniques used, or
- The site retains attributes that indicate a time period or association with an identifiable group

Assessment and Evaluation of Simple Mining Sites

Not Significant

If either Basic Documentary Data or Basic Archaeological Data is insufficient.

Data Potential Exhausted

There is no significant information contained within a Simple Mining Site and therefore no additional effort is needed to mitigate project effects on the site's data potential.

Potential Significance

The site has evidenced data potential—beyond that recovered by its identification and recordation described above—to address questions under the Research Themes presented in Chapter IV above.

SIMPLE MINING SITES WITH DOMESTIC REMAINS

In addition to displaying only non-industrial mining techniques, these sites will be distinguished by one or more deposits of domestic artifacts and/or elements of clearly domestic architectural remains (dwellings, hearth, stone baking ovens, etc.). Procedures are the same as for "Simple Mining Site" with some additions.

Procedures for Identifying and Recording Simple Mining Sites with Domestic Remains

(For Nos. 1 and 2, see "Procedures for Identifying and Recording Simple Mining Sites" above)

1. Conduct Basic Documentary Research
2. Conduct Basic Archaeological Recording
   Including completion of a DPR 523 Primary Record and Archaeological Site Record and file at Information Center
3. Evaluate Potential of Domestic Deposit
   Evaluate the data potential of the domestic component following guidelines in Town Sites and Work Camps research designs (HARD Town Sites Team 2007; HARD Work Camps Team 2007)

4. Identify History of the Site
   This involves reconstruction of mining site processes using a combination of documentary and archaeological data and addressing appropriate Themes identified above in Chapter IV

Data Required for Significance of Simple Mining Sites with Domestic Remains

Basic Documentary Data is sufficient when information on the site is supplied by at least some of the following sources, allowing Research Themes to be addressed.

- County mining claims and map files
- Reports from the State Bureau of Mines, such as those by the State Mineralogist.
- GLO Maps
- County maps
- MTPs
- County histories

Secondary material Basic Archaeological Data is sufficient when:

- The site retains sufficient integrity to demonstrate the techniques used
- The site retains attributes that indicate a time period or association with identifiable group
- The site contains sufficient archaeological remains of domestic component to answer research questions (see *Town Sites* and *Work Camps* research designs [HARD Town Sites Team 2007; HARD Work Camps Team 2007]).

Assessment and Evaluation of Simple Mining Sites with Domestic Remains

Not Significant

If either Basic Documentary Data or Basic Archaeological Data is insufficient.

Data Potential Exhausted

And therefore it is concluded that no additional effort is needed to mitigate project effects on the stie's data potential.

Mining Component. The research potential of the mining component will likely be exhausted by procedures for identifying and recording listed above

Domestic Component: The research potential of the domestic deposit should be evaluated according to procedures identified in the Town Sites and Work Camps research designs (HARD Town Sites Team 2007; HARD Work Camps Team 2007).

Potential Significance

The site has evidenced data potential—beyond that recovered by its identification and recordation described above —to address questions under the Research Themes presented

above, or as identified for domestic deposits by the *Town Sites and Work Camps research designs* (HARD Town Sites Team 2007; HARD Work Camps Team 2007).

INDUSTRIAL MINING SITES

These sites display evidence of substantial capital investment in industrial processes of extraction and/or beneficiation as evidenced by large or numerous facilities. These sites will be most common after ca. 1890 with the boom in hard-rock mining, and until modern times. Earlier industrial sites are present, however, and may be significant for their relative rarity as well as the technologies evidenced. No domestic remains are associated with this type. The level of both documentary research and archaeological recording will be guided by the size and complexity of the site.

Procedures for Identifying and Recording Industrial Mining Sites

(For Nos. 1 and 2, see "Procedures for Identifying and Recording Simple Mining Sites" above)

1. Conduct Basic and Detailed Documentary Research
2. Conduct Basic Archaeological Recording
   Including completion of a DPR 523 Primary Record and Archaeological Site Record and file at Information Center
3. Identify History of the Site
   This involves reconstruction of mining site processes using a combination of documentary and archaeological data and addressing appropriate Themes identified above in Chapter IV

Data Required for Significance of Industrial Mining Sites

Because these sites are usually found in the later years of the mining industry, and because they commonly generated a substantial volume of both public (i.e., tax and assessment, patents, etc.) and unpublished records, Basic Documentary Data (see above) must be present, as well as Detailed Documentary data found in at least some of the following:

- Claim records
- Business records
- Governments reports (*State Bureau of Mines reports*, etc.)
- Mining trade journals (*Mining and Scientific Press, Engineering News Record*, etc.)
- Local Maps, mining claim maps
- Assessment Records
- Census Reports
- Photographs
- Other resources as available and warranted such as probate records, diaries, and surveyors' notes

Detailed Documentary data is sufficient when it provides enough information to answer archaeological research questions.

Basic Archaeological Data is sufficient when:

- The site retains sufficient integrity to demonstrate the techniques used
- The site retains attributes that indicate a time period or association with group
- Mining features can be identified by function
- Mining features can be identified by systems, reflecting their role in extraction and beneficiation processes.

Assessment and Evaluation of Industrial Mining Sites

Not Significant

If either Basic Documentary Data or Basic Archaeological Data is insufficient

Data Potential Exhausted

There is no remaining significant information held by the Industrial Mining Site and therefore it is concluded that no additional effort is needed to mitigate project effects on the site's data potential.

Potential Significance

The site has evidenced data potential—beyond that recovered by this study—to address questions under the Research Themes presented above.

INDUSTRIAL MINING SITES WITH DOMESTIC DEPOSIT

In addition to evidence of industrial mining, these sites will be distinguished by deposits of domestic artifacts and/or clearly domestic architectural remains (hearth, stone baking ovens, etc.). Procedures are the same as for "Industrial Mining Site" with some additions.

Procedures for Identifying and Recording Industrial Mining Sites with Domestic Deposits

(For Nos. 1 and 2, see "Procedures for Identifying and Recording Simple Mining Sites" above)

1. Conduct Basic and Detailed Documentary Research
2. Conduct Basic Archaeological Recording
   a. map of mining remains,
   b. physical description of mining remains,
   c. photographs
   d. DPR 523 Archaeological Site Record filed at Information Center
   e. Mapping and identification of specific feature systems within site
   f. Descriptions and maps of individual features, as warranted

3. Conduct Testing
   Evaluate the data potential of the domestic component following guidelines in Town Sites and Work Camps research designs (HARD Town Sites Team 2007; HARD Work Camps Team 2007).

4. Identify History of the Site
   Reconstruction of mining site processes and associated activities using documentary and archaeological data and addressing appropriate Themes identified in Chapter IV.

Data Required for Significance of Industrial Mining Sites with Domestic Deposit

Basic Documentary Data (see above) must be present, as well as Detailed Documentary Data found in at least some of the following:

- Claim records
- Business records
- Government reports (*State Bureau of Mines reports*, etc.)
- Mining trade journals (*Mining and Scientific Press, Engineering News Record*, etc.)
- Local Maps, mining claim maps
- Assessment Records
- Census Reports
- Photographs
- Other resources as available and warranted such as probate records, diaries, surveyors' notes

Detailed documentary data is sufficient when it provides enough information to answer archaeological research questions.

Basic Archaeological Data is sufficient when:

- The site retains sufficient integrity to demonstrate the techniques used
- The site retains attributes that indicate a time period or association with group
- Mining features can be identified by function
- Mining features can be identified by systems, reflecting their role in extraction and beneficiation processes.
- Contain sufficient archaeological remains of domestic component to answer research questions (see Town Sites and Work Camps research design [HARD Town Sites Team 2007; HARD Work Camps Team 2007]).

Assessment and Evaluation of Industrial Mining Sites with Domestic Deposit

Not Significant

If either Basic Documentary Data or Basic Archaeological Data is insufficient

Data Potential Exhausted

Mining component. No additional important information is present in the mining component and it is therefore concluded that no additional effort is needed to mitigate project effects on the site's data potential. .

Domestic Component. The research potential of the domestic deposit should be evaluated according to procedures identified in the *Town Sites and Work Camps research designs* (HARD Town Sites Team 2007; HARD Work Camps Team 2007).

Potential Significance

The site has evidenced data potential—beyond that recovered by this study—to address questions under the Research Themes presented above, or as identified for domestic deposits by the research designs.

CONCLUSIONS

This chapter has presented practical methods for identifying and evaluating mining resources. Phase 1 involves two interlinked processes: identification and recording of the physical attributes of a site (property types, discussed in Chapter 3); and placement of the site in its statewide historic context (provided in Chapter 2) and local setting using historical documentary sources. During Phase 2 the site is evaluated for its research potential under themes and questions presented in Chapter 4. Key to this second phase is identification of the site as a Simple Mining Site, where its recording generally exhausts its research potential, or an Industrial Site where additional documentary and archaeological research is often required. If there is a domestic component to the mining site – remains of dwellings or a workforce's camp – relevant research themes and questions can be found in the Town Sites and Work Camps Research Designs (Caltrans 2007a, 2007b).

SAFETY CONCERNS

Mining sites can be dangerous places, and field crews should be cautious while working around them. It is important to follow strict safety procedures in order to investigate them safely. Among the basic rules are:

- **Never enter adits or shafts.**
- **Stay away from collars of shafts, as they may be unstable.**
- **Do not go into depressions on the ground, as these may be thinly covered shafts.**
- **Keep in mind that there may be dangerous chemicals present, such as mercury or arsenic, and appropriate precautions should be taken when excavating or handling soil or artifacts.**

Field crews should also become familiar with the appearance of **explosives** such as **fuses, blasting caps**, and **dynamite**. Unfamiliar artifacts should be examined with caution.

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